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SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. MCKEEN CATTELL and published every Friday by

THE SCIENCE PRESS

New York City: Grand Central Terminal

Lancaster, Pa. Garrison, N. Y.

Annual Subscription, $6.00 Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the Association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D. C.

ACADEMIES OF SCIENCE AND THE COOPERATIVE SPIRIT IN SCIENTIFIC RESEARCH[1]

By Dr. C. A. BROWNE

U. S. BUREAU OF CHEMISTRY AND SOILS

IN coming to you on this occasion as a representative of the United States Department of Agriculture and as a delegate of the American Association for the Advancement of Science I wish to convey the best wishes of both of these great scientific organizations for the success of the project which you are now inaugurating—the establishment of the Florida Academy of Sciences.

An academy of sciences has been defined as a society or corporate body which has for its object the cultivation and promotion of the whole general field of science, with no other motive than that of the pure love for scientific pursuits. The earliest prototype of such an organization was the celebrated Museum of Alexandria founded by the first of the Ptolemies in the third century, B.C., in which the most learned astronomers, geometers, mathematicians, geographers, mechanicians and devotees of the various natural sciences in the ancient Greek world gathered for consultation, study and instruction. The great benefit derived from the Museum of Alexandria is evident from the important discoveries which were made by the Greek scientists of this institution during the many centuries of its existence.

The various European academies of science which sprang into existence in the seventeenth century had a purpose very similar to that of the Alexandrian museum. Like their ancient prototype, these modern scientific academies brought together eminent specialists from different fields and thus fostered a cooperative spirit in their search for new knowledge.

It is a truism to affirm that the cooperation of scien-

[1] Inaugural address before the Florida Academy of Sciences, Gainesville, Florida, May 8, 1936.

tific men, who labor in different fields, is highly desirable, yet there has always existed a resentment on the part of certain investigators against the invasion of their domains by scientists from other realms. Sixty years ago, when Pasteur, a chemist, began to occupy himself with a study of the cause of anthrax, he was bitterly condemned as an intruder by some members of the medical profession, yet no physician to-day would deny the immense benefit which the science of medicine has derived as a result of this intrusion. In the same way Senebier, the Swiss chemist, felt it necessary in 1783 to write an apology for chemistry because certain plant physiologists objected to his using the methods of this new science to explain the behavior of green vegetation in sunlight; but now times have so far changed that no one can qualify to-day as a plant physiologist who has not been trained to employ the processes of chemistry as an aid in the solution of his problems. In fact, chemistry and its sister sciences, which were hardly on speaking terms in the time of Liebig, have to-day become so far reconciled that chemical papers are accepted as a matter of course upon the programs of physical, geological, medical, horticultural and other scientific associations.

The advantages of cooperative research are well summarized in the Greek sentence of Aristotle that has been inscribed as a motto upon the marble front of the home of the National Academy of Sciences in Washington, which states that "the search for truth is both difficult and easy, for it is evident that in its pursuit no one can either be completely successful or go wholly astray; if, however, each one makes a small contribution to natural science, the sum total of all the knowledge thus gathered together will be something considerable."

The great advantage of the cooperative as compared with the individualistic method of scientific inquiry is that the errors of the individual worker are more or less eliminated by his collaborators, each of whom approaches the problem from a different angle and that the conclusions of each individual, when viewed from all points of approach, are seen in a better scientific perspective. When properly conducted this cooperative plan of research is the most productive of all methods of scientific investigation. It was first described by one of the greatest philosophic writers of history, Sir Francis Bacon, three centuries ago, in his utopian sketch entitled "New Atlantis," where a staff of selected experts, called Solomon's House, a preconception of our modern academies of science, cooperated for the purpose of discovering new scientific truths. As the earliest detailed outline of the cooperative method of scientific inquiry, Bacon's imaginary description of the employment and offices of the fellows of his "Solomon's House" is worth quoting:

> We have twelve that sail into foreign countries . . ., who bring us the books and abstracts and patterns of experiments of all other parts; . . .
>
> We have three that collect the experiments which are in all books, . . .
>
> We have three that collect the experiments of all Mechanical Arts; and also of Liberal Sciences; and also of practices which are not brought into arts. . . .
>
> We have three that try new experiments, such as themselves think good, . . .
>
> We have three that draw the experiments of the former four into titles and tables, to give the better light for the drawing of observations and axioms out of them. . . .
>
> We have three that bend themselves, looking into the experiments of their fellows, and cast about how to draw out of them things of use and practice for man's life and knowledge, as well for works as for plain demonstration of causes, means of naturall divinations and the easy and clear discovery of the virtues and parts of bodies. . . .
>
> Then after diverse meetings and consults of our whole number to consider of the former labors and collections, we have three that take care out of them to direct new experiments, of a higher light, more penetrating into nature than the former. . . .
>
> We have three others that do execute the experiments, so directed, and report them. . . .
>
> Lastly we have three that raise the former discoveries by experiments into greater observations, axioms, and aphorisms. . . .
>
> We have also, as you must thinke, novices and apprentices, that the succession of the former employed men do not fail; besides a great number of servants and attendants, men and women. And this we do also: We have consultations, which of the inventions and experiences, which we have discovered, shall be published and which not; . . .

As a scheme for the proper conduct of scientific investigation, Bacon's plan is still commendable in many of its details, as for example in the preliminary survey of existing knowledge, the collation of all pertinent information, the making of trial tests before the actual crucial experiments, the application of the new discoveries to the enlargement of science and to the arts, the training of assistants and the selection of material for final publication. The most remarkable thing about this scheme is that Bacon without anything previous to guide him should have elaborated the plan so completely as he did and that he first suggested by his Solomon's House the idea of organized cooperative research which led to the establishment of the Royal Society and the numerous scientific academies which were founded within the half century following Bacon's death. It is interesting to note how some of these organizations seem to have imitated Bacon's plan even in matters of detail. Bacon's establishment, for example, of several scientific committees of three members each finds a later counterpart in the constitution of the reorganized French Académie

des Sciences of 1699 whose fifteen pensionaires, or working members, consisted of three geometricians, three astronomers, three mechanicians, three anatomists and three chemists. Time is lacking to trace other parallels of a similar kind.

In every extensive scientific research, whether individual or cooperative, there should be, to employ the archaic expression of Bacon, an occasional "drawing of observations" in order to determine if the drift or tendency of the results can be formulated so as to indicate certain tentative hypotheses or generalizations. New experiments under many changing conditions will then serve gradually to eliminate the suppositions which are found to be incorrect, until after a most rigid and impartial series of examinations some single one of the tentative hypotheses is accepted as the most satisfactory. This method of examination and reexamination requires, however, the utmost candor and frankness of mind, for the investigator must approach each one of the hypotheses which his scientific imagination has framed with the strictest impartiality. Nothing can be done without the imaginative faculty in scientific research, but it must not be allowed to interfere with the just performance of experimentation. The dictum of the great French physiologist, Claude Bernard, is worth remembering in this connection: "Divest yourself of your imagination, as you do of your overcoat, when you enter the laboratory; but do not forget to invest yourself with your imagination again, as you do with your overcoat, when you leave the laboratory."

Some of the world's greatest scientific investigators have failed at times to scrutinize sufficiently some tenaciously held hypothesis. Priestley, celebrated for his discovery of oxygen and other gases, long wandered in error because of his obstinate adherence to the erroneous doctrine of phlogiston. Few chemists have been so fortunate as Liebig in the making of important discoveries, yet his over-hasty desire to defend some preconceived hypothesis caused him, time after time, to go astray. One great value of the cooperative method of research is the prevention of the individual from making over-hasty generalizations and conclusions. As long as Liebig collaborated with Wöhler, he was safe, his impetuosity and haste being held in check by the calmer and more cautious temperament of his friend. No more beautiful illustration of the collaborative spirit in scientific research can be found than in the joint chemical investigations of Liebig and Wöhler. The mutual advantages of this cooperation have been described by each. Liebig in contrasting the differences of his own and Wöhler's nature expressed himself in the following words:

> While in me the predominating inclination was to seek out the points of resemblance in the behaviour of bodies or their compounds, he possessed an unparalleled faculty of perceiving their differences. Acuteness of observation was combined in him with an artistic dexterity, and an ingeniousness in discovering new means and methods of research or analysis, such as few men possess.
>
> The achievement of our joint work upon uric acid and oil of bitter almonds has frequently been praised; it was his work. I can not sufficiently highly estimate the advantage which the association with Wöhler brought to me in the attainment of my own as well as of our mutual aims, for by that association were united the peculiarities of two schools—the good that was in each became effective by cooperation. Without envy and without jealousy, hand-in-hand, we plodded our way; when the one needed help, the other was ready. Some idea of this relationship will be obtained if I mention that many of our smaller pieces of work which bear our joint names were done by one alone; they were charming little gifts which one presented to the other.

Wöhler, on the other hand, wrote as follows:

> We two, Liebig and I, have dissimilar kinds of talent; each, when in concert, strengthens the other. No one recognizes this more fully than Liebig himself, and no one does me greater justice for my share of our common work than he.

The performance of cooperative research on the part of two scientists of equal eminence, such as Liebig and Wöhler, depends for its success upon mutual good will, an absence of all envy, jealousy or suspicion and a complete renunciation of all motives of personal profit. This requirement places a severe tax upon some inherent traits of human nature, and some attempts at cooperative research have been shattered because of a suspicion on the part of one of the participants that his collaborator was reaping an undue share of the honor or gain. Yet there are many outstanding examples of brilliant pieces of cooperative research, such as those of Liebig and Wöhler just mentioned, upon oil of bitter almonds and uric acid, that of Bunsen and Kirchoff upon spectrum analysis, that of Michelson and Morley upon the velocity of light, that of Rayleigh and Ramsay upon the isolation of argon, and those of Lawes and Gilbert upon the fertilizer requirements of crops.

Administrative burdens and irritations have proved in many cases very harmful to the successful performance of cooperative research. On the other hand, where the administrative faculty is coupled with investigational ability in the person of an inspiring teacher or director great results have been accomplished. This was splendidly illustrated in the school of chemistry which Liebig established at Giessen over a century ago. The method of Liebig is one which can always be followed with profit. It was described by one of his American pupils, the late Professor S. W. Johnson, in the following words:

It was in that spirit that Baron Liebig instructed the students who gathered in his laboratory from all quarters of the globe to learn the art of making discoveries in science. They were set to testing the truth of some idea, or the connection of some fact; or else to make new observations and discover new facts to lead to new ideas. It was not the novelty or the glory of discovery, but the genuineness of discovery that was regarded as of first importance. He listened patiently to their accounts of each day's progress, considered their plan of investigation, saw the apparatus or arrangements they devised, witnessed the observations they were led to, and heard the theories they imagined. He encouraged, but he criticized. He asked questions, suggested doubts, raised objections. His students were required not only to collect facts, or supposed facts, and to connect and complement them by comparison, analogies, and theories but they were made to attack their theories in every weak point and to verify or disprove the supposed facts by scrutiny from every side.

The fruits of Liebig's teaching are a sufficient proof of the value of this method of instruction.

A more modern illustration of the same type was the school of research conducted by the late Emil Fischer at Berlin. Here was a wonderfully gifted man with a clearly defined vision of the problem to be solved and of the means for its solution and who by assigning to each one of his coworkers a specific phase of the problem was enabled by such cooperation to make contributions to organic chemistry of stupendous magnitude and importance. Other examples of what can be accomplished by cooperative research under capable sympathetic administration can be cited in the case of many modern industrial organizations, engaged in the manufacture of electrical supplies, photographic goods, optical instruments, dye-stuffs, medicines and numerous other commodities. In this instance the collaborating investigators are actuated not only by a love of science but in many cases by the financial inducements of greater income. The poet Schiller once remarked in a famous couplet that

Science to one is the mother revered by the gods; to another
Only a cow whence to squeeze profits in butter and cheese.

Some investigators, adopting the heavenly goddess view-point, regard the practical application of science to industry or commerce as degrading and mercenary; other investigators, adopting the milchcow attitude, regard research that is purely scientific as speculative and unprofitable; a third and much more sensible group takes the intermediary view that science should be cultivated with the double purpose of adding to theoretical knowledge and of contributing to human welfare. This was the attitude, I remember, of Professor Nernst in the school of physical chemistry which he established at Göttingen. He applied his theoretical investigations upon the electrical conductivity of the oxides of rare earths to the invention of a new electric lamp, and his conduct in doing this at a university devoted to pure learning was the occasion of criticism by some of his academic colleagues. Without disdaining at all the value of purely theoretical studies, we can truthfully say that only those scientists have earned the name of benefactors who have made a practical utilization of their discoveries either by increasing the means of human welfare and comfort or by removing the causes of disease and suffering. Yet it must be remarked that many inventions of the greatest utility were the indirect result of a discovery in pure science, the practical bearings of which were unforeseen or disregarded at the time.

The scientific research work of the Department of Agriculture, being in the interest of the oldest and most important of human arts, must, in its ultimate analysis, be of a most practical utilitarian character. A strict observance of immediate practicality would, however, be unfortunate in the selection of research projects, for had such a rule been universally applied some of the most important investigations in agricultural science would never have been undertaken. This is particularly true of plot experiments with soils and fertilizers such as were initiated at Rothamsted in England over eighty years ago and which are still productive of results of the greatest practical value. It is in the case of agricultural researches, which must extend over long periods of time, that a cooperative campaign is especially desirable.

We are beginning to realize more and more that the demarcations between some of our sciences are largely conventions. The boundaries of one science continually encroach upon the territory of others and it is in that fertile borderland where chemistry, physics, biology and other fields of knowledge overlap that the greatest discoveries are now being made. The biologist who, in his quest for truth, strays over the grounds of his neighbor, be he chemist, physicist or geologist, is no longer stigmatized as an intruder but is greeted instead as a welcome visitor. It is in the cultivation and encouragement of this friendly cooperative spirit between men working in different fields of research that academies of science, such as the one which you are now establishing, can serve a most useful and deserving purpose.

Numerous examples can be cited of the great benefits which have resulted from the encouragement of cooperative research by academies of science. I will select only one typical illustration in my own special field of agricultural science.

In 1834 Dr. Pallas, head physician of the military hospital of Saint Omer and the owner of a maize plantation in French Africa, presented to the French Academy of Sciences an interesting observation upon the apparent changes in sugar content of corn-stalks

during their period of growth. The question was referred by the academy to a joint committee of chemists and physicists who after consultation recommended that Pallas be encouraged to continue the investigation which gave promise of leading to conclusions of scientific and industrial importance. In a later report Pallas stated that by removing the ears of corn at the beginning of their development the sugar content of the stalks seemed subsequently to undergo a considerable increase. This important observation was referred by the academy to another committee of distinguished scientists, consisting of the agricultural chemist Boussingault, the physical chemist Regnault, the industrial chemist Payen and the physicist Biot, who reported that the conclusions were of such importance to plant physiology and industry that the problem would be taken over by Professor Biot for accurate analytical verification. Biot's brilliant solution of this problem, contained in the *Comptes Rendus* of the academy for 1842, not only verified Pallas' statement as to the increase in sugar content of cornstalks as a result of removing the ears, but it marked the establishment of a new polariscopic method, using the principle of inversion, for determining cane sugar in mixtures of other sugars—a now universally employed method which has been of inestimable value not only to pure science but to agriculture and industry in all parts of the world.

In this instance it is seen how the French Academy served not only as an agency for recording the date of an interesting scientific observation (a service of importance in settling disputes about priority) but also as a clearing house for securing the needful cooperation without which the statements of Pallas would have remained mere matters of conjecture.

For its best results cooperative research between different scientists requires frequent and open discussion. It is the opinion of many that an investigator should be uncommunicative about his ideas and results until his material is ready for publication. This is a safe rule for the solitary conservative worker who dislikes to receive criticisms or suggestions, who wishes to avoid the annoyances of premature publicity and who desires to prevent a misappropriation of his ideas by others. Cooperation in research requires, however, a loyalty and mutual confidence on the part of all members of the group who should naturally respect the wishes of each collaborator as to a policy of silence or publicity. A friendly discussion and criticism of each other's work within a group of collaborators will not only prevent the performance of useless work, but it serves to develop latent ideas which otherwise might never have been conceived. Some very brilliant scientific conceptions have been evoked by the random remark of a friend or coworker.

One of the great advantages of cooperative research, especially in a field that has so many factors and variables as agriculture, is the benefit to be derived in the interpretation of results. Probably no two scientists will draw exactly the same conclusions from a complex table of data and it is very desirable that results which are affected by numerous variables be interpreted from every possible angle. Great improvements have been made in recent years in statistical methods of analyzing numerical data, and these have been applied very successfully in agricultural research, not only to present investigations but to the results of old experiments. No less an authority than Sir John Russell, the present director of the Rothamsted Experiment Station, has declared that "a massed attack by a competent band of statisticians on the whole of the data of the best Experiment Stations, dealing with yields of crops under different conditions of nutrient supply, temperature, rainfall and other factors that go to make the aggregate called season, would yield information of extraordinary value."

It is important also during the course of a research that the accumulating data be frequently collated and studied by every collaborator in the investigation. The director of the research should go over the discussion of the data with all his coworkers, who will thus be kept in close acquaintance with the plan and progress of the work. Many valuable and expensive investigations have suffered from the death or resignation of the one scientist who was familiar with all the ramifications of the work and who alone was able to interpret the results. This could have been prevented by a more thorough plan of collaboration. One of the best illustrations of constant cooperation in agricultural research is the one employed at Rothamsted, which has already been referred to. The field plots there, according to Director Russell, "are under continual observation by a group of three workers, a physiologist, an ecologist, and an agriculturist, who study such factors as rate or habit of growth, earliness of starting or maturing, degree of resistance to insect or fungus attack; their observations are fully recorded and brought before the chemical, physical and botanical departments at regular and frequent intervals. Certain of the experiments are repeated at other centers on closely similar lines for purposes of comparison. In consequence the old field plots which have been studied for the past eighty years by Lawes, Gilbert, Warington and Hall, and might have been supposed to have no further tales to tell, are found to be still yielding results of great interest in agricultural science and practice."

It may seem contradictory to state that the most successful specialist is the one who does not always specialize. The truth of this apparent paradox can be made evident by referring again to research work in

agriculture where chemists, entomologists, plant physiologists, pharmacologists and other specialists must frequently cooperate in the solution of a common problem. It is because of this growing need of close collaboration that a scientist, in addition to attending meetings which are devoted exclusively to his own specialty, should participate also in scientific gatherings of a more general character, such as those of the American Association for the Advancement of Science or of some state or local academy of sciences, where botanists, chemists, geologists, physicists and other investigators meet for the discussion of their common problems. The great benefit of such general meetings and discussions can hardly be overstressed.

It is interesting to follow the developments of the various academies of science in different countries and to note the varying directions which the activities of each have taken. One academy will be found to lay more stress upon the rôle of science in education, another upon applied science, another upon experimentation, another upon the publication of books of outstanding scientific merit and another upon the advancement of the national culture.

The earliest association in the United States to bear the name of academy was the American Academy of Arts and Sciences, chartered at Boston in 1780. Its establishment was a part of a general movement, typified by the American Revolution, to become independent of European tutelage in all matters of national development, not only in political affiliations, but also in literature, science, art and industry. This patriotic motive was also strong in other scientific academies and lyceums which were established in the decades following the Revolution and the War of 1812. These institutions have had a varied history. Some of them, after a brief period of activity, languished and became extinct. Others that were more fortunate in location and in membership have been able to survive. The American Academy of Arts and Sciences, just referred to, is still most active and awarded grants from its permanent science fund last April of $4,670.00 to research workers in different states.

The oldest of our state scientific academies is the Maryland Academy of Sciences whose interrupted existence and several reorganizations are typical of similar developments in other American scientific societies. The Maryland organization dates back to The Academic Society, founded in 1797 by the artist Charles Wilson Peale and reorganized in 1819 by Dr. L. H. Girardin as the Maryland Academy of Science and Literature. After successive periods of prosperity and decline it was again reorganized in 1866 under the present name. The Maryland Academy of Sciences owns its own buildings in Baltimore, where it maintains a library, museum, observatory, lecture hall and laboratories. Its main objects "are to maintain a museum of science and natural history with adequate services for the public; to provide its members with opportunities for study, research and self-improvement; to provide suitable lectures, instructive discussions and conferences, and to aid in making known the resources and advantages of the State of Maryland."

Another example of suspended activity is the case of the Western Academy of Science, which was founded in Saint Louis in 1837 and was perhaps the first scientific society for cooperative research established west of the Alleghanies. After a brief period of progress, the society began to languish and finally ceased to exist. In 1856 the society was recreated under the present name of the Academy of Science of Saint Louis, which inherited the library, collections and apparatus of the older organization.

There are now 29 state and local academies of science in the United States which are affiliated with the American Association for the Advancement of Science. One great advantage of this affiliation is the incentive which it gives to the cultivation of the cooperative spirit in scientific research. It is hoped that your newly established Florida Academy of Sciences will also belong to this group of affiliated societies, who are all actuated with the common purpose of promoting scientific research and diffusing scientific knowledge. In addition to these two chief motives may be mentioned also certain other aims which are expressed in the constitutions of some of these affiliated societies, such as unifying the scientific interests of the state, promoting an interest in various departments of science, providing means for the prompt publication of papers or abstracts (a valuable service to those who wish to announce a discovery), providing opportunities for increased cooperation and fellowship, rendering public service in scientific matters and cooperating with other scientific bodies having similar aims.

It must be admitted that some of the older academies of science, in Europe as well as in the United States, have declined in later years with the rapid growth of individual scientific societies to which allegiance has been transferred. This decline can be attributed in most cases to the neglect of the cooperative spirit. Interest was kept alive in the days of the old academies by the fact that the biologist or the chemist or the geologist could comprehend what scientists in other fields were saying. As soon as the language of each science became so highly technical that it was no longer intelligible to specialists in other branches, then the members of the general science bodies, like the workers at the Tower of Babel who could no longer

"understand one another's speech," began to disband and go their several ways. It is no wonder then that the annals of some of our local academies of science have become disappointing records of dwindling membership and declining interest.

There is, however, a greater need of such academies of science as the one which you are now inaugurating than at any other period in our country's history. Such organizations may be assured of a lasting success provided they serve not only the wants of its members but also the cultural needs of the civic communities in which they are placed. Science has its cultural side as much as literature and art, but it must first be humanized, and the humanization of science consists simply in making it intelligible and interesting to every man, woman and child.

Just one hundred years ago our great American philosopher, Ralph Waldo Emerson, gave a lecture upon the "Humanity of Science," and one of the means which he recommended for giving the sciences more of a vital human interest was a study of the history of the sciences. The story of the struggles, disappointments, trials and successes of each great man of science carries with it lessons and inspirations which appeal to every child. The public should be informed not only about the history of science in general, but its interest should be aroused in the past contributions to science by the citizens of its own community and state. In the stimulation of such interest the academies of science in our different states can perform a most useful service.

The interest of the younger generation in scientific matters must also be aroused. A half century ago many of our schools had natural history clubs known as Agassiz Associations which by excursions and meetings were very useful in awakening a love for science among its youthful members. Our various state academies of science might well foster the establishment of similar clubs in our schools to-day. In fact, the establishment of junior academies of science and of high school science clubs has been actively sponsored in recent years by several of the more progressive state academies of science. Awards of diplomas of merit to young students for deserving essays upon scientific subjects would lend great encouragement to this movement. Such efforts are not wholly disinterested, for the academies later on can count upon these clubs as recruiting grounds for increasing their own memberships.

The program, ladies and gentlemen, of this first meeting of the Florida Academy of Sciences augurs well for the future of your organization. Its success will be measured not only by the immense satisfaction that you will derive from the mutual exercise of the cooperative spirit, but it will be determined to a vastly greater degree by the services which you can render to the cultural needs of the community, the state and the nation.

OBITUARY

JULIUS ARTHUR NIEUWLAND

JULIUS ARTHUR NIEUWLAND was born at Hansbeke, near Ghent, Belgium, on February 14, 1878. He died unexpectedly of an acute heart attack in the chemical laboratory of Catholic University, Washington, D. C., on June 11, 1936. A few days previously, at the annual commencement of the University of Notre Dame, he appeared in the best of health and spirits.

His parents moved to South Bend, Ind., when Nieuwland was about three years of age. He grew up in the city much as any other boy. He collected stamps and birds' eggs; but, unlike so many other naturalists, subsequently never took any interest in birds. He attended a local German parochial school; was graduated from the University of Notre Dame in 1899; was ordained priest in the Congregation of Holy Cross in 1903. He studied botany under Professor E. L. Greene and chemistry under Professor John J. Griffin at Catholic University, Washington, D. C., from which he received a Ph.D. degree in 1904.

From that time until 1918 Father Nieuwland was professor of botany at the University of Notre Dame. From 1918 until his death he was professor of organic chemistry, serving as dean of the College of Science during the years 1918 to 1922. He served as curator of the University Herbarium, of the Greene Herbarium and of the Greene Botanical Library. While he was professor of botany he used to make sets of histologic preparations and sell them, the proceeds being used in buying books for his library, which contains many old and rare volumes.

His interest in botany, while broad, was mainly devoted to the taxonomic study of the flowering plants and ferns. He never lost his interest in these groups. He often used to point out places in South Bend that once were swamps and good botanical collecting grounds, which are now well-paved city streets. His herbarium numbers about 20,000 specimens, mostly collected by his own hands, and from various parts of North America. Wherever he went he usually found time to send back at least a few plants. He was a conservationist in the broad sense; and, if there were but a single plant in an unusual locality, he was always careful to take just enough of the plant for identification and leave the rest for propagation. He deprecated the promiscuous draining of swamps and

the interference with the laws of nature by the introduction of alien species or extermination of native ones, whether of plants or animals.

A corollary of his botanical studies was the founding of the *American Midland Naturalist*, a journal devoted primarily to the natural history of the prairie states. In May, 1934, it celebrated its silver jubilee and has grown from volumes covering two years each of about 300 pages to yearly volumes of nearly 1,000 pages.

His chemical studies were devoted mainly to the synthesis of organic compounds from acetylene, which included the fundamental researches underlying the synthesis of Duprene, the outstanding synthetic rubber of to-day. Another product of his acetylene researches was developed into Lewisite by the Chemical Warfare Service, under the direction of Professor G. N. Lewis. Father Nieuwland was a member of the American Association for the Advancement of Science; the American Chemical Society, serving as secretary and as chairman of the Organic Division; the Deutsche Chemische Gesellschaft; the British Chemical Society; the Biological Society of Washington; the Washington Academy of Science, and the Indiana Academy of Science, of which he was president in 1934. He served as counselor of the St. Joseph Valley Section of the American Chemical Society for many years. He was the recipient of several medals for his work in chemistry, the most important being the Nichols medal, awarded by the New York Section in 1935. He was much pleased with the Gregor Mendel medal from Villanova College, with its ornamentation of peas.

An accomplished linguist, he spoke his own native Flemish, German, some Italian, was well versed in French, Latin and Greek. It is doubtful if there was a plant name the etymology of which in Greek and Latin was not thoroughly understood by him. This was often a chief subject of conversation on long automobile trips. He was something of a musician, knew much of classical music and was no mean performer on the guitar.

He had a happy disposition and was singularly modest. He liked children, and nearly always found a ready coin for them. He displayed a keen sense of humor, was quick at repartee, clever at paraphrasing verses and making bons mots. To find him to take on a botanical trip on Sundays or holidays, one nearly always sought him in his laboratory. He never seemed happier than in some wet meadow or tamarack bog digging up a new or unusual plant.

He will be sadly missed by his fellow members in the Indiana Academy of Science, the American Chemical Society and the University of Notre Dame that he loved and served so well.

M. W. LYON, JR.

SOUTH BEND, IND.

RECENT DEATHS AND MEMORIALS

DR. SAMUEL H. WEBSTER, head of the department of civil engineering of the Rhode Island State College, died on June 22. He was sixty-seven years old.

DR. JOHN JAMES SCHOONHOVEN, chairman of the department of zoology of the Brooklyn Institute of Arts and Sciences, died on June 27 in his seventy-second year.

Nature writes: "The death of Sir Frederick Macmillan on June 1, at eighty-four years of age, ends a remarkable triumvirate in the history of the firm of Messrs. Macmillan and Company, Ltd., the publishers of *Nature* ever since it was founded by them and Sir Norman Lockyer in November, 1869. At that time the firm consisted of Alexander Macmillan, who died in 1896, and George Lillie Craik, who died ten years later. During their lifetime three other partners were admitted — Frederick Orridge Macmillan (1874), George Augustin Macmillan (1879) and Maurice Crawford Macmillan (1883). By a most tragic set of circumstances, these three directors have all passed into silence within a period of three months. George Macmillan died on March 3, Maurice Macmillan on March 30 and on the day of his brother's funeral Sir Frederick slipped on the floor of his dressing-room and this accident led to his death."

THE following deaths are also announced in *Nature:* Professor Francis Cavers, formerly professor of biology in University College, Southampton, author of text-books on elementary botany, on May 26. Sir Archibald Denny, Bart, ship-builder and engineer, formerly president of the Institute of Marine Engineers and in 1918–27 chairman of the British Engineering Standards Association, on May 29, aged seventy-six years.

THE *Journal* of the American Medical Association states that a monument erected on the grave of Dr. Perry H. Millard, the first dean of the University of Minnesota Medical School at Minneapolis, was dedicated in Fairview Cemetery, Stillwater, on June 7. In addition, a suitable plaque is to be placed in the university and surplus funds collected for the memorial are to be turned into the general fund of the Medical Alumni Association. The principal address at the dedication ceremonies was delivered by Dr. James T. Christian, of St. Paul. Other speakers included Dr. William J. Mayo, of Rochester, Minn., a regent of the university; Dr. Elias P. Lyon, dean of the Medical School; Dr. Guy S. Ford, dean of the Graduate School, and Dr. Edward A. Meyerding, secretary of the Minnesota State Medical Association.

THE Royal Scottish Geographical Society proposes

to raise a fund for the establishment of a memorial to the late Dr. Marion Newbigin, who for thirty years edited the Scottish Geographical Society's magazine. Subscriptions are invited from friends who wish to take some part in commemorating her services to geography. These should be sent to the Treasurer, Royal Scottish Geographical Society, Synod Hall, Castle Terrace, Edinburgh.

SCIENTIFIC EVENTS

REPORT OF THE BRITISH ASTRONOMER ROYAL

As is customary on the first Saturday in June, the Board of Visitors of the Royal Observatory assembled at Greenwich to make their annual visitation and to hear the Astronomer Royal's report. The members of the board are the presidents and six fellows each of the Royal and the Royal Astronomical Societies, the Savilian professor of astronomy at Oxford, the Plumian professor of astronomy at Cambridge and the hydrographer of the Admiralty.

The London *Times* states that in beginning his report, which referred to the year ended April 30 last, Dr. Spencer Jones, Astronomer Royal, described the counterpoise system adopted for the new reversible transit circle, the erection of which was practically completed at the end of March, in order to relieve the weight on the bearings.

In a free-pendulum clock now nearing completion, which is being presented by H. R. Fry, time will be taken directly off the free pendulum by a photo-electric method.

The sun, moon, major and minor planets and fundamental stars were regularly observed with the transit circle. The observations of the moon continued to show a decrease in the correction to the longitude given by Brown's tables, which were introduced into the *Nautical Almanac* in 1923. The correction, which was then 9 sec. of arc, fell last year to little more than 3 sec.

Regular observation of the brighter minor planets has been resumed in view of the attention recently given to the possibility of using them for fixing equinox and equator point. Further progress was made with the measurement of the photographs taken of the planet Eros at various observatories in 1930–31.

Among meteorological observations the amount of solid matter polluting the air was regularly measured by an Owens automatic filter and was found on the whole to be substantially less in the winter of 1935–36 than in the previous winter, probably because of the much smaller proportion of wind coming from a northerly direction. Gaseous pollution of the atmosphere by sulfur dioxide appeared to vary greatly from day to day.

In the worst days of January and February, in both 1935 and 1936, this pollution approached and occasionally exceeded 0.2 parts by volume in a million, but on good days less than one tenth of this amount was present. Pollution is found to be greatest on days of calm air, drifting from a northerly direction, generally accompanied by fog. It is reduced to a minimum by a strong southerly wind.

The mean temperature of the year was 50.2 deg. F., or 0.7 deg. higher than the average of the 75 years 1841–1915. The total rainfall was 26.11 in., or 1.87 in. more than the average for the 75 years 1841–1915. The wettest month was November, with 3.59 in., and the driest July, with 0.56 in.

FLOOD CONTROL

SECRETARY OF AGRICULTURE HENRY A. WALLACE has announced that problems of "up-stream" engineering in relation to flood control and land conservation will be discussed at a conference of experts from the United States and foreign countries in Washington, on September 22 and 23.

The conference will be called by a special committee appointed by President Roosevelt. Members of the committee are H. H. Bennett, chief of the Soil Conservation Service; Morris L. Cooke, administrator of the Rural Electrification Administration, and F. A. Silcox, chief of the Forest Service.

In announcing the conference, Mr. Wallace made public a letter from President Roosevelt pointing out the need for coordinating land-use principles with existing knowledge of down-stream engineering methods in federal planning for flood control and land conservation. The President's letter follows:

> Up-stream engineering will have a major part in efforts to save the land and control floods, and for that reason it offers a broad field of opportunity for the engineering profession. I am therefore in hearty accord with your suggestion that there be held an open conference on the subject in the early fall. The date might well be in proximity to that of the Third World Power Conference in September, in the hope that some of the distinguished foreign engineers attending the latter may be interested also in contributing to the proposed conference.
>
> There are indications that a substantial body of technical information on the control of little waters is now available in the scattered records of American experience —federal, state and professional. The urgent problem is to bring these data together into a coordinated body of engineering knowledge so that public officials and engi-

neers may have a more definite picture of up-stream engineering as an important field of public and professional activity.

There is a wealth of experience and data as to down-stream engineering and works required for navigation, power development and flood control—levees, large dams, great reservoirs and channel improvements on major streams. But necessary as these are for the safeguarding of those who live in areas subject to destructive floods and of property located therein, it must be remembered that down-stream waters originate largely in up-stream areas. The objects of up-stream engineering are through forestry and land management to keep water out of our streams, to control its action once in the stream and generally to retard the journey of the raindrop to the sea. Thus the crests of down-stream floods are lowered.

In accordance wth your further suggestion I am appointing as a committee to organize and promote such a conference or institute: Hugh H. Bennett, chief of the Soil Conservation Service, Department of Agriculture; Morris L. Cooke, administrator of Rural Electrification Administration, and F. A. Silcox, chief of the Forest Service, Department of Agriculture.

THE MONTREAL BOTANICAL GARDEN

WORK on the construction of the Montreal Botanical Garden, which had been in prospect for several years, has been commenced this spring. The garden is administered by a commission of five, which includes the directors of the botanical departments of both the University of Montreal and McGill University.

Frère Marie-Victorin, director of the Institute of Botany at the University of Montreal and author of "Flore Laurentienne," has been named director of the garden. Henry Teuscher, formerly director of the Boyce Thompson Arboretum and later dendrologist of the New York Botanical Garden, has been engaged as superintendent and chief horticulturist to design and to lay out the garden and to take charge of its horticultural activities.

An administration building, two greenhouses and a modern heating plant, all of which were built three years ago, are now in operation. A nursery has been prepared and, as a first display unit, an economic garden has been laid out, which is to serve for the instruction of school children and which will exhibit this year 124 varieties of fodder-plants, grain-crops, vegetables, oil-plants, etc.

The first section of the garden, comprising about 150 acres, is expected to be ready for inauguration by 1942 for the tricentennial celebration of the founding of Montreal. Eventually the garden is to cover almost 600 acres of ground.

This fall the Montreal Botanical Garden expects to contribute for the first time to the international seed exchange, which is maintained between the botanical gardens of the world, by offering seeds of various interesting and little known Canadian plants.

THE NATIONAL ASSOCIATION OF SCIENCE WRITERS

THE election of Howard W. Blakeslee, science editor of the Associated Press, as president of the National Association of Science Writers has been announced recently. Mr. Blakeslee succeeds David Dietz, science editor of the Scripps-Howard Newspapers, who had held the office of president since the organization of the association in September, 1934.

Other officers elected for the ensuing year include: William L. Laurence, science news editor of *The New York Times, vice-president;* John J. O'Neill, science editor of *The New York Herald-Tribune, treasurer;* Thomas R. Henry, of the *Washington Star, secretary.*

Active members of the association, in addition to those already named, include Watson Davis, director of Science Service; Victor Henderson, of the *Philadelphia Inquirer;* Waldemar Kaempffert, science editor of *The New York Times;* Gobind Behari Lal, science editor of the Hearst newspapers; Herbert B. Nichols, physical science editor of *The Christian Science Monitor;* Frank Thone, biology; Robert D. Potter, physics and chemistry; Jane Stafford, medicine, and Marjorie Van De Water, psychology, staff members of Science Service; Steve McDonough, of the Associated Press, and Allen Shoenfield, of the *Detroit News.*

F. B. Colton, of the National Geographic Society, is an associate member. Austin H. Clark, of the Smithsonian Institution, and Dr. J. McKeen Cattell, editor of SCIENCE, are honorary members.

The association was formed "to foster the dissemination of accurate scientific knowledge by the press of the nation in cooperation with scientific organizations and individual scientists." Active membership is limited to staff members of newspapers and press associations, who devote their major efforts to the field of science writing.

THE PITTSBURGH MEETING OF THE AMERICAN CHEMICAL SOCIETY

CELEBRATING the sixtieth anniversary of its founding, the American Chemical Society will hold a five-day meeting in Pittsburgh, beginning on September 7. Dr. Edward Ray Weidlein, director of the Mellon Institute of Industrial Research, Pittsburgh, president-elect of the society, has been named honorary chairman of the meeting, which it is expected will be attended by more than 3,000 chemists, industrialists, educators, government workers and scientific men representing allied fields. Chester G. Fisher, president of the Fisher Scientific Company, is chairman of a local committee of one hundred and five members who will arrange a local program with the cooperation of the industries, the U. S. Bureau of Mines and the educational institutions of the district.

Nineteen scientific divisions of the society will hear reports of progress in practically every field of chemical science. Four sessions will be devoted to coal. Chemists from England, Germany and the United States will speak on the hydrogenation of coal under the auspices of the Division of Gas and Fuel Chemistry.

Research to be reported at other sessions includes the fields of agricultural and food, biological, cellulose, colloid, fertilizer, industrial and engineering, medicinal, organic, paint and varnish, petroleum, physical and inorganic, rubber, sugar and water, sewage and sanitation chemistry; the history of chemistry, chemical education and microchemistry.

The secretaries of the divisions are:

Agricultural and Food Chemistry: H. R. Kraybill, Purdue University.

Biological Chemistry: C. A. Elvehjem, Agricultural Chemistry Building, University of Wisconsin.

Cellulose Chemistry: W. O. Kenyon, Research Laboratory, Eastman Kodak Company.

Chemical Education: N. W. Rakestraw, department of chemistry, Brown University.

Colloid Chemistry: Richard Bradfield, department of soils, Ohio State University.

Fertilizer: H. C. Moore, P. O. Box 1685, Atlanta, Ga.

Gas and Fuel Chemistry: Alden H. Emery, Room 728, Mills Bldg., Washington, D. C.

History of Chemistry: Mildred W. Grafflin, *Chemical Abstracts,* Ohio State University.

Industrial and Engineering Chemistry: Erle M. Billings, State St., Rochester, N. Y.

Leather and Gelatin Chemistry: Edwin R. Theis, department of chemical engineering, Lehigh University.

Medicinal Chemistry: D. L. Tabern, Abbott Laboratories, North Chicago, Ill.

Organic Chemistry: Ralph L. Shriner, department of chemistry, University of Illinois.

Paint and Varnish Chemistry: G. G. Sward, 2201 New York Ave., N. W., Washington, D. C.

Petroleum Chemistry: C. R. Wagner, Pure Oil Company, 35 East Wacker Drive, Chicago, Ill.

Physical and Inorganic Chemistry: H. S. Booth, Western Reserve University.

Rubber Chemistry: C. W. Christensen, Rubber Service Laboratories Company, 1012 Second National Bank Bldg., Akron, Ohio.

Sugar Chemistry: E. W. Rice, National Sugar Refining Company of New Jersey, 129 Front St., New York, N. Y.

Water, Sewage and Sanitation Chemistry: C. R. Hoover, 8 Pike Place, Middletown, Conn.

Microchemical Section: Frank Schneider, school of chemistry, Rutgers University.

THE MATHEMATICAL ASSOCIATION OF AMERICA

THE twentieth summer meeting of the Mathematical Association of America will be held during the week of August 31–September 5, at Harvard University in connection with its tercentenary and in conjunction with the summer meeting of the American Mathematical Society and the Institute of Mathematical Statistics. Meetings of the Association for Symbolic Logic and of the American Astronomical Society will also be held during the same week.

This is the first week of the Harvard Tercentenary Conference of Arts and Sciences. Among the scholars whom Harvard University is inviting as lecturers are several eminent mathematicians. Through the courtesy of the university their lectures will be delivered before the society. The addresses (titles tentative) will be given in the New Lecture Hall. On Tuesday afternoon at two o'clock Professor E. J. Cartan, of the University of Paris, will deliver a lecture entitled "L'extension du calcul tensoriel aux géométries non affines." Professor L. E. Dickson, of the University of Chicago, will speak on Wednesday at 10:45 A.M., his subject being "Waring's Problem and its Generalizations." Professor G. H. Hardy, of the University of Cambridge, will deliver on Thursday morning at 9:30 an address on "The Mathematical Work of Ramanujan." Professor Tullio Levi-Civita, of the University of Rome, will deliver at the Friday morning session at 9:30 an address entitled "The Relativistic Problem of Several Bodies."

At a joint meeting of a section of the society with the Association for Symbolic Logic on Tuesday at 10:45 A.M. in Emerson Hall, Room 211, Professor Rudolf Carnap, of the Deutsche Universität, Prague, will speak, his topic being "Truth in Mathematics and Logic." Friday afternoon at 2:30 in the Lecture Hall there will be a joint session of the society and the American Astronomical Society, the subject being "Cosmogony." Professor Levi-Civita will give an address on "Astronomical Consequences of the Relativistic Problem of Two Bodies," and Sir A. S. Eddington, of the University of Cambridge, will speak on "The Cosmical Constant of and the Recession of the Nebulae." These addresses will be followed by discussion.

The Colloquium Lectures of the American Mathematical Society on "Topics in General Analysis" will be delivered by Professor E. W. Chittenden, of the University of Iowa, on Tuesday, Wednesday and Friday mornings, and on Thursday afternoon in Emerson Hall. Each lecture will be scheduled for approximately one hour. A fee of two dollars will be charged for attendance at any or all of these lectures. By invitation of the society, Professor G. C. Evans, of the University of California, will give at the Saturday morning general session in Emerson Hall D an address entitled "Methods of Modern Analysis in Potential Theory." In addition to those mentioned above, the

society will hold sessions for the presentation of regular papers on Tuesday and Thursday morning and afternoon in Emerson Hall.

The Tercentenary Conference has arranged several evening lectures (titles tentative). Besides that of Professor Hardy on Monday evening, there will be on Wednesday evening an address by Professor Étienne Gilson, of the Collège de France, on "Scholastic Philosophy," on Thursday evening by Professor Edward Joseph Dent, of the University of Cambridge, on "Some Aspects of Music," and on Friday evening by Professor John Dewey, of Columbia University, on "Authority and Resistance to Social Change." Admission will be either by ticket issued by Harvard University or by registration badge of the mathematical organizations.

An informal joint dinner of the mathematicians and their guests will be held on Thursday evening in Lowell House and Winthrop House. These houses adjoin one another and the after-dinner program of addresses will take place in Lowell House to which those dining in Winthrop House may adjourn. Professor J. L. Coolidge, master of Lowell House, will be toastmaster, and there will be addresses by President Conant, of Harvard University, by some of the guests of the university and by others.

SCIENTIFIC NOTES AND NEWS

DR. HARLOW SHAPLEY, director of the Harvard College Observatory, has been elected a member of the Norwegian Academy of Sciences.

DR. CALVIN B. BRIDGES, of the Carnegie Institution of Washington, who has been working in association with Dr. T. H. Morgan, at the California Institute of Technology, on the heredity and cytology of Drosophila, has been elected a corresponding member of the Academy of Natural Sciences of Philadelphia.

M. V. GRÉGOIRE, professor of botany at the University of Louvain, has been elected a correspondent of the Paris Academy of Sciences in the section of botany. He takes the place of the late Hugo de Vries.

THE following have been elected foreign members of the Linnean Society of London: Professor M. L. Fernald, curator of the Gray Herbarium of Harvard University; Dr. B. A. Fedschenko, professor of botany at the University of Leningrad; Professor P. Pelseneer, permanent secretary of the Royal Academy of Sciences, Belgium; Dr. K. F. von Tubeuf, professor of the anatomy, pathology and physiology of plants at the University of Munich, and Dr. W. M. Wheeler, professor of entomology, emeritus, at Harvard University.

THE Royal Medals of the Royal Geographical Society have been awarded as follows: The Founder's Medal to G. W. Murray, director of desert surveys, Egypt, for his long-continued explorations and surveys in the deserts of Sinai and eastern Egypt, for his studies of Badawin tribes and his unstinted help to desert expeditions, and the Patron's Medal to Major R. E. Cheesman, C.B.E., for valuable service to geography during nine years' residence in N. W. Ethiopia, including reconnaissance and surveys of the course of the blue Nile and exploration of Lake Tana and its islands. The Victoria Medal has been awarded by the council to Dr. Stanley Kemp, for his work in surveys of the Southern Ocean; the Murchison Grant to Michael Leahy, for his explorations of Central New Guinea; the Back Grant to Muhammad Ayub Khan, for his surveys on three expeditions under the leadership of Sir Aurel Stein, in East Persia, 1931–34; the Cuthbert Peek Grant to T. H. Harrisson, to assist him in his proposed expedition to New Guinea, and the Gill Memorial to Lieutenant A. L. Nelson, R.N.R., for his charts of the South Sandwich Group, South Orkneys and South Shetlands.

AT the recent convocation of the University of Toronto, honorary degrees were conferred on seven graduates of the university. Those conferred in the sciences were the doctorate of laws on Dr. George Fred Kay, professor of geology and dean of the College of Liberal Arts of the State University of Iowa, and the doctorate of science on Dr. William Henry Collins, director of the Geological Survey of Canada; on Dr. Ralph S. Lillie, professor of general physiology in the University of Chicago, and on Thomas Reeve Rosebrugh, who retires this year from the chair of electrical engineering in the University of Toronto, after serving on the staff since 1890.

MIDDLEBURY COLLEGE conferred on June 15 the doctorate of laws on Dr. Karl T. Compton, president of the Massachusetts Institute of Technology, who gave the commencement address, and on Dr. William Otis Hotchkiss, president of the Michigan College of Mining and Technology. The degree of doctor of science was conferred on Dr. Eugene C. Bingham, professor of chemistry at Lafayette College, and on Dr. Philip Wheelock Ayres, forester of the Society for the Protection of New Hampshire Forests.

THE degree of doctor of science was conferred on Ira N. Gabrielson, chief of the U. S. Biological Survey, at the sixty-seventh annual commencement exercises of the Oregon State College at Corvallis on June

DR. W. J. KERR, chancellor emeritus of higher education of Oregon and formerly president of the institution, in conferring the honorary degree read the following tribute: "Ira Noel Gabrielson—Biologist, naturalist, original contributor of scientific literature, authority on alpine plants, for twenty years a trusted representative of the United States Department of Agriculture in charge of rodent control in Oregon, executive of large resources and scientist of wide recognition, long cherished as one of Oregon's leading citizens and recently honored by being advanced to the high post of chief of the United States Bureau of Biological Survey, with headquarters at the national capital."

J. W. FINCH, director of the U. S. Bureau of Mines, received an honorary degree of doctor of laws at the commencement exercises of the University of Alabama following the dedication of the new Southern Experiment Station of the bureau at Tuscaloosa.

AT the commencement exercises of the John B. Stetson University on June 8 the honorary degree of LL.D. was conferred on Dr. John Joseph Kindred, consulting physician to the River Crest Mental Hospital at Astoria, Queensboro, New York City. Dr. Kindred has been for several years professor of medical jurisprudence in the law department. He was for ten years a member of the U. S. House of Representatives from Queensboro.

THE Stacey Award of the College of Medicine of the University of Cincinnati, consisting of a medal and an honorarium of $100, has been awarded to Dr. Bernard Langdon Wyatt, of Tucson, Ariz. The award is given for a significant contribution in the field of focal infection.

DEAN EMBURY A. HITCHCOCK, of the College of Engineering of the Ohio State University, will retire from active service at the end of the summer quarter. In recognition of his long-time membership on the university faculty he has been voted the rank of dean emeritus by the board of trustees. Pending the selection of a permanent dean, Junior Dean William D. Turnbull has been named acting dean and acting director of the Engineering Experiment Station. Associate Professor John M. Weed, assistant director of the experiment station, has been designated acting junior dean.

DR. SAM Z. LEVINE, of Cornell University Medical School, has been promoted to be professor of pediatrics and head of the department.

DR. KASIMIR FAJANS has been appointed professor of general and physical chemistry at the University of Michigan and will assume this position in September. Dr. Fajans has been associated with the University of Munich since 1917, serving as professor of physical chemistry from 1925–1934 and recently as director of the Physical-Chemical Institute. He is the author of contributions in the fields of radioactivity, isotopes, crystal structure, atomic structure, chemical forces and refractometry.

DR. C. E. MARSHALL, of the University of Leeds, England, has been appointed visiting professor in the department of soils at the University of Missouri for the coming academic year. He will temporarily occupy the position held by Dr. Hans Jenny, who has accepted an appointment at the University of California at Berkeley. Dr. Marshall is known for his work in soil colloids.

DR. RALPH K. STRONG, head of the department of chemistry at Reed College, has been appointed to succeed Dr. John White as head of the department of chemistry at the Rose Polytechnic Institute.

AT Vanderbilt University promotions from assistant professor to associate professor in the Medical School include Dr. George Summers Johnson, surgery; Dr. Thomas D. McKinney, clinical surgery; Dr. Alvin E. Keller, preventive medicine and public health; Dr. C. C. McClure, radiology. From instructor to assistant professor, Dr. Thomas C. Butler, pharmacology, and Dr. Nathaniel Sehorn Shofner, clinical surgery.

DR. CARL EUGEN GUTHE, director of the Museum of Anthropology, lecturer in anthropology and chairman of the Division of the Social Sciences at the University of Michigan, has been made director of the University Museum.

DR. GERALD WENDT, editor of *Chemical Reviews*, formerly assistant to the president of the Pennsylvania State College, has been elected director of the American Institute of the City of New York, succeeding L. W. Hutchins, who has resigned to devote himself to his business interests.

NEW appointments at the Psychopathic Clinic of the Recorder's Court of the City of Detroit are: assistant director, Dr. John A. Larson, formerly assistant criminologist for the State of Illinois and assistant professor of psychiatry at Rush Medical College; junior sociologist, Dr. Stuart Lottier, formerly teaching fellow in sociology at the University of Michigan, and junior psychologist, Dr. Dwight Chapman, formerly instructor in psychology at Harvard University.

Industrial and Engineering Chemistry reports that Raymond M. Fuoss, for the past three years assistant professor of chemistry for research at Brown University, has become a member of the chemical staff in the Research Laboratory of the General Electric Company, Schenectady, N. Y.

THE following students are carrying on their work at the Marine Biological Laboratory at Woods Hole this summer with the assistance of *The Collecting Net* scholarships which were awarded last fall: Walter E. Martin, instructor in zoology, Purdue University; Virginia Mayo, chairman of the department of science, Dana Hall School; John R. Pappenheimer, research assistant in physiology, Harvard University; Daniel McQ. Lilly, instructor in biology, Providence College, and Jay Smith, assistant embryologist, the Johns Hopkins University. *The Collecting Net*, a weekly journal devoted to marine biological laboratories, has awarded thirty-seven such scholarships since its foundation in 1926.

DR. E. M. K. GEILING, chairman of the department of pharmacology of the University of Chicago, has left for the whaling station at Rose Harbor, Queen Charlotte Island, in order to obtain a supply of the pituitary gland of the whale. Dr. Geiling has been carrying on his work at Rose Harbor, four hundred and fifty miles northwest of Vancouver, during the past two summers. On this trip he will be accompanied by Dr. Robert Walmsley, of the University of Edinburgh, fellow of the Rockefeller Foundation, who is making the trip primarily to study the vascular system, and Lewis L. Robbins, research assistant.

ROBERT W. HODGSON, professor of subtropical horticulture and assistant director of the branch of the College of Agriculture of the University of California at Los Angeles, has gone to India to conduct a horticultural mission in one of the native states in the Punjab region. He has been granted six months' leave of absence. On completion of his work in India he expects to visit the date-growing regions of Arabia, Iraq and Egypt and the principal fruit experiment stations in the Orient.

DR. WILLIAM D. HARKINS, professor of chemistry at the University of Chicago, has been elected George Fisher Baker non-resident lecturer in chemistry at Cornell University for the first term, 1936–37.

DR. J. VON NEUMANN, professor of mathematical physics at Princeton University, gave recently four lectures at the University of Paris.

THE Board of Scientific Directors of the Rockefeller Institute for Medical Research announces the following appointments and promotions on the scientific staff to take effect on or after July 1, 1936: Promotions: *Associate to associate member,* Dr. Irvine H. Page. *Assistant to associate,* Dr. Alexandre Rothen, Dr. John M. Steele and Dr. Robert S. Tipson. *Fellow to assistant,* Dr. W. Halsey Barker, Dr. Rollin D. Hotchkiss, Dr. Hubert S. Loring and Dr. George L. McNew. New appointments: *Associate,* Dr. Rafael Lorente de Nó. *Assistants,* Dr. Robert D. Baird, Dr. Georg K. Hirst, Dr. Horace L. Hodes, Dr. Austin L. Joyne Leonard C. Kreider, Dr. Charles L. Mehltretter, D Benjamin F. Miller, Dr. Carl G. Niemann and D John A. Saxton, Jr. *Fellows,* August A. Di Somm and Dr. Carl G. Harford.

ACCORDING to *Museum News,* at a meeting held Kimberley on April 23, the South African Museum Association was organized. A constitution wa adopted and officers elected for the current year follows: *President,* C. J. Swiestra, director of th Transvaal Museum, Pretoria; *Secretary-Treasurer,* C. Chubb, curator of the Durban Museum and A Gallery, Durban; *Councilors,* E. L. Gill, director the South African Museum, Cape Town; J. Hewit director of the Albany Museums, Grahamstown; E. van Hoepen, director of the National Museum, Bloem fontein, and P. Thatcher, keeper of the South Afric National Gallery, Cape Town.

A MEETING of the Australian and New Zealan Association for the Advancement of Science is to b held in Auckland, New Zealand, from January 12 t 19.

THE fifteenth Japanese Congress of Physiology wi be held in August at the Ohara Institute of Kurashik Oyama.

THE Smith College field studies in geology will b continued in the Black Hills of South Dakota and t Bear Lodge Mountains of Wyoming during the prese summer. The faunal and stratigraphic investigati of the Deadwood formation will be continued, with t collaboration of Dr. Christina Lochman, of Mou Holyoke College; the study of the Mississippian-Pen sylvanian contact will be concluded; and an analy of the region's erosional landforms will be start The work will be under the general direction of Pr fessor H. A. Meyerhoff.

THE American Pharmaceutical Association a nounces the award of a grant or grants amounti to $1,000, which will be available on October 1, research on medicinal substances. Applications shou be addressed to Professor H. V. Arny, chairman the Committee on Research, American Pharmaceuti Association, 115 West 68th Street, New York City.

THE Edison Industries Exhibition at the New Yo Museum of Science and Industry in Rockefel Center opened on June 27. It includes demonstr tions of the evolution of telegraphy, telephony, lig power, the phonograph, motion pictures, talking p tures, the radio and other fundamental factors modern civilization from the early experiments a basic discoveries of Edison through successive sta of progress to the most advanced developments.

organizing the exhibit, the museum has been aided by the Thomas Alva Edison Foundation and a number of leading industrial concerns.

Museum News reports that deeds have been accepted by the Secretary of the Interior to 22,817 acres and surface and cave rights to 4,743 acres of the Mammoth Cave area, sufficient to give it National Park status. The deeds were turned over to the Government by the Kentucky National Park Commission. Recreational development of the new park will await the acquisition of a major portion of the remainder of the authorized maximum of 70,618 acres.

AT a recent congregation of the University of Oxford, Sir Farquhar Buzzard, Regius professor of medicine, introduced a statute creating an Institute of Experimental Psychology in the university. He said that the need for such a foundation had long been felt, and a committee of the General Board drew up seven years ago a report, which the council approved but could not put into effect because of financial stringency. An anonymous donation of £10,000 and an allocation from the Rockefeller trustees of £500, together with £150 per annum for the next five years have been received. Under the terms of the donation the first director of the new institute would be the Wilde reader in mental philosophy, Dr. William Brown.

FIVE South African mining and finance houses, the Anglo-American Corporation of South Africa, the Central Mining and Investment Corporation, the Consolidated Goldfields of South Africa, the New Consolidated Gold Fields and the Union Corporation have each made a donation of £1,000 to the Cavendish Laboratory to be devoted to any purpose of the Cavendish Laboratory which those in charge of the administration may decide.

THE general board of the University of Cambridge proposes to establish a post of assistant director of research in medicine. He will work in Addenbrooke's Hospital and the laboratories of the university under the direction of the Regius professor of physic, and if the university approve the proposed post the appointment will be for an initial period of three years at £700 a year.

THE twenty-fifth annual report of the Brooklyn Botanic Garden, for the year 1935, comprises a brief survey of the first quarter century of the garden. During this period the City of New York has appropriated a total amount of $2,039,664 for permanent improvements and maintenance, and the Board of Trustees has provided private funds amounting to $1,618,056 for the same purpose. The contract between the city and the board obligated the board to provide only $50,000 of private funds. During 1935 the board of trustees provided nearly 52 per cent. of the maintenance budget so that the city, as the report points out, secured two dollars worth of public service for every dollar it appropriated. The total registered attendance for the year exceeded 1,624,000, with a record week-end attendance on May 11 and 12 of more than 43,000. The attendance at regular Botanic Garden classes was nearly 66,000 and visiting classes from city schools of more than 49,000. Thirty-three pages of the report are devoted to summaries of the research work of the garden's personnel for the year. Plant material was supplied to 10,891 teachers in 297 schools and colleges in all five boroughs of Greater New York for the instruction of 470,855 students. More than one million packets of seeds were supplied to school children for the planting of school and home gardens. Reports of progress in research projects are given as follows: Plant pathology, leguminous tubercles, types of algae, regeneration and polyploidy, iris, forest pathology (chestnut blight), systematic botany, coffee and tobacco pharmacology.

DISCUSSION

ORIGIN OF THE SUPPOSED METEORITE SCARS OF CAROLINA

THE Coastal Plain of the Carolinas and northeastern Georgia exhibits a vast number of elliptical depressions partially surrounded by rims of sand. Such depressions, as well as others more irregular in form, are locally called "bays." Attention was first directed to their peculiarities some forty years ago by Glenn,[1] but not until Melton and Schriever[2] ascribed to them an extra-terrestrial origin did they attract wide popular as well as scientific attention. The two authors last named, in a paper giving an excellent account of the major characteristics of the bays, advanced the hypothesis that the oval depressions were produced by the impact of a great shower of meteorites. It was suggested that the meteoritic shower may have represented the nucleus of a comet which collided with the earth and that the direction of approach was from the northwest.

C. Wythe Cooke,[3] Erwin Raisz,[4] Fletcher Watson,

[1] L. C. Glenn, SCIENCE, n. s., 2, 472–475, 1895.

[2] F. A. Melton and William Schriever, *Geol. Soc. Amer. Bull.*, 44: 94, 1933; *Jour. Geol.*, 41, 52–66, 1933. F. A. Melton, *Discovery*, 15: 151–154, 1934; *Jour. Geol.*, 42: 97–104, 1934.

[3] C. Wythe Cooke, *Jour. Geol.*, 42: 88–96, 1934.

[4] Erwin Raisz, *Jour. Geol.*, 42: 839–848, 1934.

Jr.,[5] and the writer[6] have at different times expressed doubts as to the validity of the meteoritic hypothesis of origin. Cooke advanced the suggestion that the elliptical sand rims are in part wave-formed bars and beaches built in shallow lagoons during a higher stand of the sea, and in part crescent-shaped keys formed in shallow lakes. Prouty[7] and MacCarthy,[8] on the basis of magnetometer surveys, have supported the meteoritic hypothesis as advanced by Melton and Schriever, while Nininger[9] in his volume on "Our Stone-Pelted Planet" has apparently accepted the meteoritic hypothesis of bay origin as demonstrated. In the present brief communication it is not possible to analyze the arguments for and against the different interpretations advanced. This will be done somewhat fully in a small volume[10] now in preparation. But since the fuller discussion can not appear for some months, it seems desirable to set forth here certain results of recent observations in the "bay" country.

On the basis of field studies of bays in the Myrtle Beach area of South Carolina the writer in 1934 advanced the hypothesis that the bays represented former lake basins which had been rounded to the symmetrical oval form by wave action, while the rims were accumulations of windblown sand derived from the shores of the shallow lakes. A possible explanation for orientation of the ovals in a NW-SE direction was sought in the direction of the most violent winds, but without complete success. For while meteorological records demonstrated prevailingly greater intensities from the southeast in the southern part of the area, this was not true for the northern area. What wind conditions might have been during the glacial epoch remained problematical. No attempt was made to explain the origin of the lake basins, as sufficient evidence was not then available.

During the spring of 1936 the writer examined, in greater or less detail, more than one hundred of the bays scattered throughout seventeen counties in North Carolina, South Carolina and Georgia. In preparation for this examination he was greatly aided by the generous cooperation of Professor William F. Prouty, of the University of North Carolina, who placed at his disposal information and maps which greatly facilitated the study, and who accompanied the writer on a visit to some of the remarkable bays in Bladen County, North Carolina. The observations made in the three states seem to justify the following generalizations:

(1) The rims partially surrounding the oval depressions are not composed of the material constituting the coastal plain strata in which the depressions occur, as should be the case were they scooped up by meteoritic impact. They consist uniformly of clean, fairly coarse sand, identical in character with known windblown sand in these regions. Occasional sections show that beneath the sand rim the horizontal coastal plain beds remain undisturbed.

(2) The rims of sand are not heaped up symmetrically about the southeastern halves of the oval depressions, as might be expected were they ploughed up by meteoritic impact. Although exceptions occur, the locus of major sand accumulation is prevailingly along the southeastward portion of the northeastern sides of the oval bays and part way round the southeastern ends—in other words, prevailingly about the southeast quadrants of the bays. This fact was acutely observed and clearly stated by Glenn for the bays near Darlington, South Carolina, in his paper of forty years ago. But its significance was not then apprehended, and the fact itself has since escaped attention. Such distribution of the rims implies that a force (possibly dry winds following clear, drying weather) transported sand in one direction, whereas the force which formed the bays operated in a distinctly different direction.

(3) The oval bays are very frequently associated in a most intimate manner with numerous typical sinkholes of limited dimensions, steep sides and irregular form. Every conceivable transition can be traced from the small irregular sinks to the most symmetrical large bays.

(4) The larger and more symmetrical bays often occur where a thick deposit of sand or sandy loam covers a formation which elsewhere shows smaller and more irregular sinks. It seems inevitable that a small, irregular sink occurring in a soluble formation at some depth, must produce a larger, shallower and more symmetrical depression at the surface of an overlying bed of loose sand or sandy loam.

(5) The distribution of oval bays is found to correspond with the distribution of known beds of limestone, marl and coquina to such an extent as to create a strong presumption that there exists a genetic relationship between the two. In some places where bays occur in areas not known to be underlain by calcareous beds, layers of chert breccia or other deposits

[5] Fletcher Watson, Jr., *Popular Astronomy*, 44: 2–17, 1936.

[6] Douglas Johnson, Nat. Acad. Sci., Abstracts of Papers Presented at the Scientific Sessions, April 23 and 24, 1934, p. 30; also SCIENCE, n. s., 79: 461, 1934; Geol. Soc. Amer., Preliminary List of Titles and Abstracts of Papers to be Offered at the forty-eighth annual meeting, New York, N. Y., December 26–28, 1935, p. 16.

[7] W. F. Prouty, *Jour. Geol.*, 43: 200–207, 1935; Geol. Soc. Amer., Preliminary List of Titles and Abstracts of Papers to be offered at the forty-eighth annual meeting, New York, N. Y., December 26–28, 1935, p. 25.

[8] Gerald R. MacCarthy, Geol. Soc. Amer., Preliminary List of Titles and Abstracts of Papers to be offered at the forty-eighth annual meeting, New York, N. Y., December 26–28, 1935, p. 21.

[9] H. H. Nininger, "Our Stone-Pelted Planet," 237 pp., Boston, 1933. See frontispiece and its title.

[10] To be published by the Columbia University Press, New York City.

indicate the former presence of limestone or similar soluble formations. In other places the supposed absence of calcareous beds may well be due to the obvious insufficiency of available data; for marl deposits occur widely scattered as isolated patches under a concealing cover of Pleistocene sands, and the drilling of new wells from time to time reveals the presence of buried patches of marl the existence of which was formerly unsuspected.

(6) The orientation of the axes of oval bays is not nearly so uniform as has been supposed. The prevailing direction is northwest-southeast; but bays trending more or less nearly north-south are by no means rare, and examples trending northeast-southwest are known. The prevailing direction corresponds to the general trend of surface drainage when the coastal plain was raised above sea-level, and to the presumable direction of major groundwater flow, especially prior to extensive incision of surface valleys.

(7) The number of oval bays appears to be vastly greater than has generally been supposed. In the field one may count scores where the topographic maps show few. Aerial photographs which the United States Geological Survey kindly permitted the writer to examine show hundreds where the observer on the ground would be able to find only scores. They occur not by thousands, but certainly by tens of thousands if not by hundreds of thousands. Any acceptable theory of origin must account for the development of these forms in numbers which can fairly be characterized as "countless."

The facts summarized above, based for the most part on new observations covering a wide area, justify presentation of the following working hypothesis of bay origin: The depressions are due, directly or indirectly largely to solution of calcareous beds at varying depths below the surface, but possibly in smaller measure to the solution of alumina and iron in arkosic beds, after the manner described by Smith.[11] The fact that the soluble beds are usually buried by later formations accounts in part for the observed symmetry of form, as well as for failure of the sinkhole hypothesis to receive adequate recognition when the bays were first discovered. Lakes and ponds formerly occupied many of the sinks. Wave action perfected and to some extent altered the initial symmetry, and concentrated sand upon the shores. Winds then blew the beach sands upon the borders of the sinks, maximum accumulation occurring upon that part of the border toward which winds moved sand most effectively. This depended upon a number of variable factors, among which are the seasonal factor (when groundwater and lake levels are lowest and beaches best exposed), the cyclonic factor (when winds occur without rain and follow periods of clear, drying weather), as well as the variable strength of winds from different directions.

The terms "sink" and "sinkhole" have here been used in their broad, generic sense, to indicate surface depressions due directly or indirectly to differential removal of underlying soluble formations. It is fully recognized that in any karst region some solution cavities serve for the descent of surface waters underground, others for the return of such waters to the surface; and that the same openings may serve alternately first for one purpose and then for the other. Prouty has noted the fact that where lakes still occupy bays the water supply may come principally from "lake-bottom springs." That such supply may be copious is demonstrated by the large outflow from White Lake in Bladen County, North Carolina, cited by Prouty as an example of a bay filled with water coming chiefly from below. Others have found that waters entering sinkholes in one part of the coastal plain reappear at slightly lower levels in marshy bays, the outlet waters of which are relatively rich in calcium carbonate. In his field studies, and in his studies of topographic maps and aerial photographs, the writer has been impressed by the fact that great numbers of the oval bays, including many not at present occupied by lakes, have prominent outlet channels now draining, or formerly draining, into surface streams.

It is obvious that where uprising waters pass through loam they may remove the silt or clay, leaving the sand as residue. Wave action on lakes may similarly separate fine from coarse material. Where lake waters bearing clay or silt in suspension escape into surface streams, there may in time be a notable loss of solid matter. It has repeatedly been observed that far more material has been removed from the oval bays than can be found in the surrounding rims. It seems reasonable to suppose that this fact may often be due in greater measure to water transport from the basins, than to settling of surface sands into cavities formed in underlying soluble formations.

The foregoing is presented as a reasonable working hypothesis, not as a definitive solution of the puzzling bay problem. It seems to account for most characteristics of the bays more satisfactorily than any hypothesis previously advanced. Yet some phases of the hypothesis require further scrutiny. Whether solution of calcareous or other soluble beds by southeastward moving groundwater will explain the degree of parallelism observed in bay orientation or whether winds have influenced orientation remains to be determined. The fact that some bays occur in regions not yet known to be underlain by soluble rocks has already been noted. Account must be taken of the evidence produced by Prouty and his associates to show the

[11] Laurence L. Smith, *Jour. of Geol.*, 39: 641–652, 1931.

existence of magnetic highs (attributed to the presence of meteoritic bodies) near the southeastern ends of certain bays. These and other aspects of the problem will be fully discussed in the forthcoming account of the bays; and further evidence will be presented which seems to support the hypothesis that the bays are essentially the product, direct or indirect, of solution; and the encircling rims accumulations of wind-drifted sand.

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ALKALI DEFICIENCY AND FISH MORTALITY

IN the January 24 issue of SCIENCE, Dr. P. B. Sears suggests that the mortality of fish at Wallingford, Conn., reported by Mr. Tomlinson (SCIENCE, November 1, 1935), was primarily due to reduction in the quantity of "soluble alkaline minerals by the time the unsettled weather conditions . . . made their appearance." This interesting suggestion is unfortunately not confirmed by the chemical data obtained at the time of the mortality. When the reservoir was visited on August 2, 1935, the day following the mortality, the alkalinity of both surface and bottom water was found to be 57.9 p.p.m. as HCO_3. This value is comparable to that obtaining in a strongly eutrophic lake near North Branford, Conn., now under intensive investigation, and considerably higher than the alkalinity of other moderately eutrophic lakes in Connecticut. Moreover, the Wallingford locality had completely recovered its oxygen on September 28, 1935, when Mr. G. A. Riley and I revisited it, without any appreciable change in alkalinity (57.3 p.p.m.). It is therefore clear that a reduction in the alkali reserve played no part in producing the mortality.

A more extended discussion of the phenomenon will appear elsewhere.

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BACTERIOSIS OF PUMPKIN FRUITS IN CALIFORNIA

IN September, 1935, an outbreak of a soft rot of young pumpkin fruits (*Cucurbita pepo,* L. var. *condensa,* Bailey) was observed near San Pablo, Calif. The disease affected immature fruits of the varieties Early White Bush Scallop, Yellow (or Golden) Summer crookneck, Zucchine and Danish, being especially destructive on all but the latter variety. Counts showed a loss of from 60 to 75 per cent. of fruits in one field, with comparable losses in other plantings. Warm moist weather appears to favor this disease, which spreads rapidly through the agency of insects, particularly *Diabrotica sp.* Isolations made from infected fruits yielded a bacterium which upon repeated inoculations and reisolations has proved to be the causal agent. A similar organism was secured from two different localities in California and from pumpkin fruits grown at Corvallis, Oregon.

The disease affects only immature fruits. Infection of carrot roots and celery by the same organism also occurs under natural conditions.

The characteristic soft rot was produced in the following hosts: pumpkin fruits (22 horticultural varieties), carrot, celery, lettuce (leaves and stalk), cabbage (leaves and stalk), cucumber, turnip, onion, melon (four varieties), tomato fruits (green and ripe), cauliflower (leaves and stalk), stock, Opuntia (five species). The pathogen was identified as belonging to the genus Erwinia, since it possesses peritrichiate flagella. Though related in several ways it is not typical of *Erwinia carotovora* (L. R. Jones) Holland, from which it differs by having a different host range and distinct morphological and physiological characters.

Morphologically, the organism is a short rod measuring $1\,\mu - 1.2\,\mu \times 0.6\,\mu - 0.8\,\mu$. It is Gram negative and produces acid and gas in sucrose, but only acid in dextrose, glycerine, mannose, lactose, arabinose, invert sugar, salicin and amygdalin. The most striking difference from *E. carotovora* was observed on the eosin-methylene blue agar slants. On this medium *E. carotovora* produces a beautiful metallic luster comparable to that of *Escherichia coli* (Escherich) Castellani and Chalmers, while the pumpkin organism developed a light pink color in the growth without discoloring the medium. The pathogen could not be agglutinated in 2 per cent. NaCl solution at 96° C, while *E. carotovora* was agglutinated in 50 minutes. The optimum for growth is from 25° C to 31° C, while the upper thermal death point is 48.5° C.

A detailed study of the taxonomic position of the pathogen and of the susceptibility and resistance of pumpkin varieties is in progress.

P. A. ARK
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A NEW ESTROGENIC SUBSTANCE FROM OVARIES

IN the course of a series of studies carried out on the nature of unsaponifiable substance of various tissues, we have been able to isolate from ovaries a crystalline substance possessing a melting point of 95.1° C. (uncorrected), molecular weight of 320 (Rast) and of the following composition: C, 73.47 per cent.; H, 12.32 per cent.; N, 4.43 per cent.; O (by difference), 9.78 per cent.; which indicates a probable empirical formula—$C_{30}H_{41}O_2N$.

Biological assay on spayed rats indicates that .00001 milligram of the substance injected in a single dose

will produce positive estrus after 96 hours. The animals remain in heat for at least 24 hours with a gradual return to the resting stage. Even on large doses, estrus does not appear earlier than 96 hours, but persists for several days.

The crystals consequently differ both chemically and physiologically from urinary estrogenic substances, such as theelin and theelol.

This work will be reported in greater detail in another journal.

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VISITING LECTURERS AND THE UNIVERSITY'S BUDGET

ONE of the advantages which European universities have over American ones is the tradition that favors itineracy among students. The ballyhoo over football and other forms of activity rooted in provincialism have so conditioned the American student's mind that university loyalties generally outweigh loyalty to intellectual standards and to personal growth. As a consequence a large proportion of graduates and almost all undergraduates, once they are matriculated in one university, will not move to another. Hence little use is made by the student of that variety of background and view-point available in a nation where over fifty thriving universities offer exactly this advantage. Thus once more, though in a new setting, arises the problem of Mohamet and the Mountain.

The relatively few American universities blessed with a very large endowment are enabled to solve this problem by means of separately created visiting lectureships. For budgetary reasons, however, this method is not open on any appreciable scale to most of our institutions.

An alternative is a plan now followed by the Department of Geology and Geography at Northwestern University. Another institution is invited to set up an exchange arrangement involving no cost to either university except the subsistence and transportation of the visitors. Honoraria are not called for and salary items remain as normally fixed in the budget. Exchanges are made for a week of lectures only, and thus the visitor's schedule at his own institution is not badly disrupted, especially if his class work during his absence is shared by his own colleagues. Whenever possible, the exchange is arranged to affect men who are students in the same field and are dealing in their advanced classes with about the same subjects, concurrently. Thus, each visitor stimulates and broadens the view-point of the other's classes. In return he receives the vivifying comments of students reared in a differing tradition. Staff members of the cooperating departments are similarly stimulated.

The plan has been in effect with conspicuous success for five academic years. Exchanges have been effected with the University of Cincinnati, the George Peabody College for Teachers, Harvard University and Washington University in St. Louis. Perhaps by increasing such a practice those American universities which can not defray the cost of expensive visiting lectureships may still be able to spread among their students a healthy appreciation of the catalysis that comes from an exchange of ideas with outsiders.

CHAS. H. BEHRE, JR.
NORTHWESTERN UNIVERSITY

THE DOCTOR OF PHILOSOPHY DEGREE AND MATHEMATICS RESEARCH

DEAN RICHARDSON, of Brown University, secretary of the American Mathematical Society, has prepared a careful and interesting report on the doctor's degree and mathematical research, published in the April number of the *American Mathematical Monthly*, which will be of great service to American mathematicians and others. This report and the data available in Dean Richardson's office contain such fundamental statistical information as the names of all Americans who have received the doctorate in mathematics, the names of foreign mathematicians who have joined our American mathematical group, the research papers presented to the society and subsequently published by each of these persons, and the names of all teachers of mathematics in American universities, colleges, normal schools and junior colleges during the year 1935–36.

In the report printed in the *Monthly*, details are given (1) concerning the number of degrees conferred in successive five-year periods from 1870 to 1935 by each American university, (2) concerning research productivity of the doctors of mathematics analyzed in various ways, (3) concerning the productivity of doctors who received their degrees at various leading universities, and (4) concerning the productivity of National Research Council fellows.

According to Dean Richardson's statistics, the total number of doctorates in mathematics conferred by American universities during the period 1862–1934 is 1,267, of which 168 were conferred on women. Foreign universities conferred 114 doctorates in mathematics on persons who have been active in America. The average number of pages of research published annually by persons holding the doctorate in mathematics has been slightly less than five. Over half of those holding the doctorate have published at most one research paper, and only 11 per cent. have published more than ten such papers.

The number of teachers of mathematics in American

and Canadian colleges and universities in 1935 was 4,444, of whom 1,292 possessed the doctor's degree. The number of these teachers who were in junior colleges was 746, in teachers colleges 373 and in other colleges 3,325. The men numbered 3,750 and the women 694; and 1,263 were members of the American Mathematical Society.

E. J. MOULTON

SOCIETIES AND MEETINGS

THE NORTH CAROLINA ACADEMY OF SCIENCE

THE thirty-fifth annual meeting of the North Carolina Academy of Science was held at Duke University, Durham, N. C., on April 24 and 25, 1936. The meeting was unusually well attended. Sixty-five papers and four exhibits made up a full and interesting program. The proceedings, several abstracts and some complete papers will appear at an early date in the *Journal of the Elisha Mitchell Scientific Society*.

The General Section met the first day for the presentation of papers of general interest, after which the annual business meeting was held. This was followed by a tea in the Duke University Medical School Library and a tour through the Medical School and Hospital. The annual show of the School of Engineering was also visited by many of the academy members.

In the evening a complimentary dinner was extended to the academy by Duke University, at which an address of welcome was made by Dr. W. C. Davison, dean of the Duke University Medical School. This was followed by an inspiring address, "The Teacher of Science," by the retiring president, Professor W. L. Porter, of Davidson College.

The forenoon of the second day was set aside for the more technical papers in the meetings of the following sections: General Section (botany, zoology, forestry, geology), Chemistry Section, Mathematics Section and Physics Section. At the conclusion of the sectional meetings a tour was made through Duke Forest.

During the business meeting resolutions of respect were read, honoring the memories of Mr. T. G. Harbison, of Highlands, North Carolina, for several years curator of the Herbarium of the University of North Carolina; Dr. Horace W. Frink, psychoanalyst, connected with the University of North Carolina Medical School and formerly of the faculty of Cornell University, and Charles F. Meserve, formerly president of Shaw University.

The academy elected to life membership Dr. J. S. Holmes, state forester of the North Carolina Department of Conservation and Development, and Dr. I. H. Manning, recently retired dean of the University of North Carolina Medical School. The executive committee reported the election of twenty-five new members during the year and the reinstatement of seven former members.

In the high-school science essay contest, sponsored by the academy, first prize was awarded to Carl Deal, Boyden High School, Salisbury, N. C., for his essay, entitled "The Sea, a Mine." The contest will be continued in 1936 in the fields of biology and geography.

Professor F. G. Hall, of the Department of Zoology, Duke University, was awarded the Phipps and Bird medal for the most noteworthy paper, entitled "Physiological Studies at High Altitudes."

The following officers were elected for the coming year:

GENERAL SECTION

President, P. M. Ginnings, Greensboro College.
Vice-President, C. F. Korstian, Duke University.
Secretary-Treasurer, H. L. Blomquist, Duke University.
Executive Committee, the above officers and W. E. Speas, Wake Forest College; H. R. Totten, the University of North Carolina; W. L. Porter, Davidson College.

CHEMISTRY SECTION

Chairman, Edward Mack, Jr., the University of North Carolina.
Vice-chairman, W. C. Vosburgh, Duke University.
Secretary-Treasurer, E. C. Markham, the University of North Carolina.
Councillor, L. A. Bigelow, Duke University.
Executive Committee, the officers and R. W. Bost, the University of North Carolina; C. S. Black, Wake Forest College; W. A. Reid, North Carolina State College.

MATHEMATICS SECTION

Chairman, J. H. Roberts, Duke University.
Secretary-Treasurer, J. M. Clarkson, North Carolina State College.

PHYSICS SECTION

Chairman, M. L. Braun, Catawba College.
Secretary-Treasurer, J. S. Meares, North Carolina State College.

The thirty-sixth meeting of the North Carolina Academy of Science will be held in 1937 at Catawba College, Salisbury, N. C.

H. L. BLOMQUIST,
Secretary

THE NEBRASKA ACADEMY OF SCIENCE

THE forty-sixth annual meeting of the Nebraska Academy of Science was held at Nebraska Wesleyan University, Lincoln, on May 8 and 9. In spite of rain the attendance was fully up to normal. The Nebras

Section of the Mathematical Association of America, the Nebraska Council of Geography Teachers, the Nebraska Science Teachers Association and the Nebraska Dietetic Association met jointly with the academy.

Three general sessions were held, and addresses of general interest given. Dr. Earl H. Bell, assistant professor of anthropology at the University of Nebraska, gave an address on "Red Pioneers of Nebraska"; Herbert B. Loper, captain, Corps of Engineers, U. S. Army District Engineer, Omaha, explained the "Design and Construction of Missouri River Regulating Works"; and Dr. J. J. Hompes, physician and surgeon, Lincoln, gave an illustrated address on a "Physician's Impressions of India." Only favorable reports of these meetings were received by the secretary.

Attendance at the banquet was limited by the rain, but those who did attend were well repaid by the music furnished by the Wesleyan Conservatory of Music and the informal discussion and demonstration of a new projectoscope by Dr. E. E. Lackey, professor of geography at the University of Nebraska.

One new feature of the meeting was a sectional program by the newly organized Junior Academy of Science. In fact, high-school science teachers found their time and interests divided between this section and the science teachers section. More than the usual number of high-school teachers were present, largely because of the double interests.

A total of 116 papers were presented at the various sectional meetings, and 14 projects presented at the junior meeting.

The following officers were elected: *President,* Dr. J. E. Weaver, University of Nebraska; *Vice-president,* Dr. Harry R. James, Hastings College; *Councillor* for three years, Dr. C. J. Shirk, Nebraska Wesleyan University. The secretary and treasurer are elected only on the odd-numbered years.

Announcement was also made that the 1935 "grant-in-aid" awards had been made to Dr. G. Robert Coatney, Peru State Teachers College, and to Professor Robert L. Graig, McCook Junior College; and the 1936 awards to Dr. G. Robert Coatney, Peru State Teachers College, and Miss Eunice Haskins, Stella, Nebraska.

Chairmen of sections for the 1937 meeting will be: Biochemistry and Nutrition, Dr. C. W. Ackerson; Biology, Dr. John M. Winter; Earth Science, Dr. E. H. Bell; History of Science, ...; Physics, Professor Chris Keim; High School, Professor Harold E. Wise; Chemistry, Dr. E. R. Washburn; Geography, Professor Durfee Larson; Mathematics, Dr. C. C. Camp; Social Science, Dr. C. E. McNeill.

M. P. BRUNIG,
Secretary

SCIENTIFIC BOOKS

THE THEORY OF FUNCTIONS

An Introduction to the Theory of Functions of a Complex Variable. By E. T. COPSON. Oxford University Press, 1935; 448 pp. $8.50.

THIS volume is based on lectures given to undergraduates in the Universities of Edinburgh and St. Andrews. Assuming a knowledge of mathematical analysis such as is contained, for example, in Hardy's "Course of Pure Mathematics" (Cambridge, fifth edition, 1928), the book affords an introduction to a number of branches of the theory of functions of a complex variable.

The first six chapters deal with the classical theory of single-valued differentiable functions. The remaining nine chapters have the following respective headings: VII. Integral functions; VIII. Conformal representation; IX. The gamma function; X. The hypergeometric functions; XI. Legendre functions; XII. Bessel functions; XIII. The elliptic functions of Weierstrass; XIV. Jacobi's elliptic functions; XV. Elliptic modular functions and Picard's theorem. The miscellaneous examples occurring at the end of each chapter include many significant theorems and contribute materially to the attractiveness of the book.

The matric definition of complex numbers introduced in Chapter I is worthy of note. The treatment of analytic functions is based on the Cauchy integral theorem. A function is said to be analytic in a domain if it is single-valued and differentiable at every point of this domain, save possibly for a finite number of exceptional points. In the opinion of the reviewer, this is one of the less preferable uses of the greatly overworked term "analytic." Cauchy's theorem is proved for a polygonal contour by a method due to E. H. Moore. Reference is then made to a paper of S. Pollard for the details of the passage from a polygonal contour to a general rectifiable simply closed curve. Pollard's work is dependent upon the theory of chains of regions as developed by de la Vallée Poussin. In addition to the statement and indication of proof of the more general form of Cauchy's theorem, there is given an elementary proof of the theorem for the case of a simply closed curve which consists of a finite number of arcs having continuously turning tangents. The proof is the usual one

involving Green's theorem; however, Green's theorem is not proved in either of the two references cited by the author for a region bounded by such a general contour. The inclusion of more extensive bibliographies on the proofs of Cauchy's theorem and Green's theorem would have enhanced the value of Chapter IV.

Chapters VII and VIII are good introductions to their respective subjects. In considering these chapters, however, the student is to be reminded of the admonition given in the preface that the book is not intended to be encyclopedic in character. One of the most interesting sections of the volume is that dealing with the application of saddle-point integration to the problem of determining asymptotic expansions of the Bessel functions. The work on modular functions culminates with the proof of Picard's theorem, together with the extension of this theorem due to Carathéodory. By way of conclusion, references are given to the elementary proofs of Picard's theorem due to Borel, Bloch and Nevanlinna.

For the most part, and in all the basic work, the proofs given are modern in character and sufficiently complete in detail for the thoughtful reader. The reviewer noted a few places, however, which are likely to trouble the student. For example, on page 16 it is stated without proof that a non-decreasing bounded sequence tends to a limit. In a later section, on page 21, it is proved that an arbitrary sequence of real numbers has maximum and minimum limits. One wonders why the order of these two sections was not interchanged. In the preliminary discussion of Cauchy's theorem on page 59 the author has omitted the assumption that the domain be simply connected. It is to be remarked that in many places the term "domain" is used without specifying whether an open domain or a closed domain is meant. In several statements made in Chapter IV it is necessary to interpret "domain" as meaning "open domain."

Due to the comprehensive treatment of the subject-matter of Chapters X–XII, this book will appeal to those interested in differential equations. In evaluating the work as a whole, however, the reviewer feels that an unduly large proportion of the book is devoted to the study of particular functions, rather than to the general methods of function theory. This opinion is strengthened when one considers the omissions. The subject of analytic extension and the definition of the complete analytic function, using the terminology of the author, receive a very meager treatment. The entire geometrical aspect of analytic function theory is missing, and the terms "Riemann surface" and "algebraic function" do not appear in the book. There is no mention of analytic functions of two or more complex variables. These comments are not to be interpreted as adverse criticism. They are intended to emphasize, however, that this work shares with many other books on the subject the property of not affording in itself a complete and balanced introduction to this important field of mathematical analysis.

The printing is excellent and the proofreading must have been done with great care. The reviewer noted only a few misprints, and these were of minor character. This book will doubtless be widely used as an introductory text on the subject.

W. T. REID

THE UNIVERSITY OF CHICAGO

TAXONOMY

Procedure in Taxonomy, including a reprint of the International Rules of Zoological Nomenclature with Summaries of Opinions Rendered to the Present Date. By EDWARD T. SCHENK and JOHN H. McMASTERS. Stanford University Press. viii + 72 pp. Price, $2.00.

THIS timely little volume should prove very useful to all taxonomists, and serve as a guide to the younger group of naturalists unfamiliar with the rules and regulations which have been agreed upon by the International Congress of Zoology.

It is divided into eight chapters, the first of which constitutes the introduction and discusses binomial nomenclature. The second defines the systematic categories into which the animal kingdom is divided. The third discusses types and recommends a reduction of the many kinds of types that have been defined by superspecialists in recent years, recommending the use of a small number of definite type terms, all of which are in general use now. Chapter 4 offers suggestions for description of new species, which one hopes will be followed by the coming generation of naturalists and which, if followed, will make comparison easier than is the case at the present time. Chapter 5 discusses the problem of specific names, while Chapter 6 deals with synonymy. Here again we find excellent suggestions. Chapter 7 offers basic suggestions where type material should be deposited, carefully avoiding the mentioning of such repositories, merely suggesting the qualifications that an institution should possess to merit being the custodian of type material. Chapter 8 deals with "Latin Terms and Abbreviations."

Pages 27 and 56 are devoted to a reprint of the International Rules of Zoological Nomenclature, together with the addition of the amendments to Article 25 of that code, that is, the article that covers the law of priority.

The last 17 pages are devoted to an index.

This little volume should find a place on the shelves of every zoological laboratory and worker in systematics, since it brings into very convenient form the method of taxonomic procedure now almost universally employed by systematists.

PAUL BARTSCH

SPECIAL ARTICLES

BIOLOGICAL EFFECTS OF HOMOLOGOUS THYMUS IMPLANTS IN SUCCESSIVE GENERATIONS OF RATS[1]

IN a previous communication, attention was called to the accruing acceleration in the rate of growth and development when successive generations of rats were given daily intraperitoneal injections of 1 cc of potent thymus extract (Hanson). It seemed likely that, if these phenomena were due to a substance inherent to the thymus gland and present in the extract, frequent implantations of homologous thymus implants in successive generations of rats would produce similar results.

Accordingly, 3 pairs of albino rats of the Wistar strain were given weekly implants of whole thymus glands, each animal receiving a total of 12 implants. The glands were obtained from stock rats between the ages of 20 to 50 days. Starting with the third generation, the implants were made at 5-day intervals. These implants were placed subcutaneously in different sites on the back and neck of the recipient. Sloughing of about one third of the implants was noted. The remainder were absorbed and grossly disappeared in about 2 weeks.

In transplanting the thymus gland, the recipient was first fastened by a specially constructed holder, an area of the back prepared by cutting the hair and infiltrating a small area of the skin with a few drops of 1 per cent. procain solution. An incision was made through this area, a subcutaneous pocket prepared and the surface of the underlying muscles abraded. A mattress suture was inserted and the first knot loosely tied. The donor was stunned, its thymus gland immediately removed and transferred to the prepared site in the recipient. Not more than thirty seconds elapsed between the time the donor was sacrificed and the final tying of the mattress suture in the skin of the recipient.

To date four successive generations of animals implanted with thymus glands have been observed. An analysis of the biological data of each of these generations reveals certain significant facts. In the first generation (F_0), no effect was apparent. The litters were large, the offspring at birth strong and of good size. In the second generation (F_1), there was noted a slight increase in the rate of growth, as revealed by body weight, especially between the tenth to the seventeenth days of life, reaching a maximum excess of 9 per cent. at the age of 40 days. In the third generation, the increase in growth was greater than in the second, again reaching a maximum excess of 12 per cent. at the age of 40 days. Three litters have been born in the fourth generation. As in preceding generations, acceleration in growth was noted, reaching a maximum excess of 16 per cent. at the age of 40 days.

The animals in the third and fourth generations were vigorous, and active. At the age of 12 to 14 days, they scampered about their cages in a manner like that of the control animals at the age of 20 days. One litter of the fourth generation was successfully weaned at the age of 12 days and given their first implants at the age of 15 days.

A study of the somatic changes revealed findings more striking than the increase in the rate of growth. Reference to Table 1 shows that in the second generation there was only a slight acceleration in the opening of the ears, the eruption of the teeth, the appearance of hair, the opening of the eyes, the descent of the testes and in the opening of the vagina. In the third generation, these somatic changes were further accelerated, while the most marked acceleration was observed in the fourth generation. Thus in the latter generation, the average time for eruption of the teeth, appearance of hair, opening of the eyes, descent of the testes and opening of the vagina was 5, 9, 7, 24.3 and 36 days, respectively (Table 1).

TABLE 1

COMPARISON OF SOMATIC DEVELOPMENT IN SUCCESSIVE GENERATIONS OF THYMUS IMPLANT STRAIN OF RATS WITH DEVELOPMENT OF CONTROL ANIMALS

	Ears open	Teeth erupted	Hair appeared	Eyes open	Testes descended	Vagina open
Controls	2–3 (2.9)	7–10 (8.5)	11–14 (12.5)	13–17 (15.2)	24–35 (30.2)	39–50 (44.3)
F_1	2–4 (2.9)	7–9 (8.1)	12–16 (13)	13–16 (14.7)	25–33 (28.2)	39–56 (44.6)
F_2	2–3 (2.5)	6–9 (7.1)	11–13 (12.1)	9–16 (13.1)	19–30 (24.5)	37–52 (40.7)
F_3	2–3 (2.2)	4–9 (6.8)	10–13 (11.3)	9–14 (11.8)	20–28 (24.6)	36–42 (39)
F_4	1–3 (2)	3–7 (5)	8–10 (9)	5–9 (7)	18–28 (24.3)	32–42 (36)

The experimental data here presented indicate that frequent homologous thymus implants into albino rats result in an accruing acceleration in the rate of growth and of development of the young. Although this acceleration is not so marked quantitatively as that resulting from the daily intraperitoneal injections (1 cc) of thymus extract, yet qualitatively it is in every respect identical in nature, the difference in results probably being due to the quantitative difference in the

[1] From the Philadelphia Institute for Medical Research, the Samuel Bell, Jr., Laboratory, in the Philadelphia General Hospital. Part of thesis studies by the senior author submitted to the faculty of the Graduate School of Medicine, of the University of Pennsylvania, in partial fulfilment of the requirements for the degree of doctor of medical science (ScD. Med.).

active principle concerned. These experiments with homologous implants afford important confirmation of our previously reported evidence as to the biological effect of thymus extract.

N. H. EINHORN
L. G. ROWNTREE

THE SECRETION OF AN ANTIDIURETIC HYPOPHYSEAL HORMONE IN RESPONSE TO THE NEED FOR RENAL WATER CONSERVATION

EVIDENCE that the posterior lobe of the pituitary gland secretes a hormone concerned with the normal regulation of mammalian water metabolism is still incomplete. The classification of the posterior hypophysis as a gland of internal secretion is the result of two types of experimentation: first, the chemical isolation from the hypophysis of a substance possessing marked anti-diuretic activity in normal, unanesthetized hydrated animals, and, second, the occurrence of polyuria and polydypsia following degeneration or removal of the posterior pituitary and their relief by administration of pituitary extracts. From such evidence it has been deduced that the hypophysis secretes a hormone which enables the kidney to reabsorb water against an osmotic pressure in the renal tubule higher than that of the blood. No one, however, has demonstrated the presence in any body fluid of an anti-diuretic substance secreted by the posterior hypophysis in response to a physiological need.

The regulation of water retention and excretion in the mammalian organism is so well adjusted that the degree of body hydration is maintained within narrow limits. If renal water reabsorption is under hormonal control, an exceedingly labile relationship should exist between the secreting gland and the end organ to permit such accurate function. For such a labile system, two requirements are necessary: (1) the degree of hypophyseal activity must be readily adjusted to the body requirements for renal water reabsorption, and (2) the hormone must be easily inhibited or destroyed to permit diuresis following hydration. The postulate of a labile system does not seem to be fulfilled when one considers that the polyuria of diabetes insipidus can be relieved for many hours by the administration of a single unit of pitressin. That this is many times the effective dose, however, has been shown by Theobald,[1] who observed antidiuresis in one individual after the administration of 0.0005 units. That pitressin is readily destroyed by the body has been clearly demonstrated by Heller and Urban,[2] who proved its rapid inactivation by blood and tissues. They also observed that a portion of the injected pitressin is excreted in the urine. It would appear, therefore, that the kidney is extremely sensitive to minute amounts of this pituitary extract and the body is capable of rapidly eliminating amounts exceeding its physiological requirements.

The above facts suggest that the secretion of an antidiuretic substance is capable of effecting an accurate and sensitive control of renal water reabsorption. The demonstration that such a control actually exists and that it represents a true hormonal regulation of water reabsorption would be complete if it could be shown that the anti-diuretic substance is secreted in amounts varying with the need for water conservation. This necessitates the detection of this substance in body fluids and a method of quantitative estimation sufficiently sensitive to measure physiological variations in amounts.

The logical body fluid to examine for the presence of an anti-diuretic hormone would be the blood, were it not for the fact that extremely low concentrations are physiologically effective, and such minute amounts are readily inactivated. The observation that injected pituitrin passes through the glomerulus and is excreted in the urine, a medium in which the hormone is presumably more stable, offers another body fluid in which an anti-diuretic substance might be demonstrated. Heller and Urban failed to detect anti-diuretic activity in normal rat urine. If one increases the need for water reabsorption by dehydration, presumably this should result in greater hypophyseal activity and the urinary excretion of the anti-diuretic hormone in increasing amounts. The experiments to be described are based upon the above postulates.

Rats, dogs, monkeys and man were used as experimental subjects. Dehydration was accomplished either by the oral administration of 5 per cent. NaCl solution or by water deprivation over periods varying up to 72 hours. Urine was collected in vessels containing sufficient 1 per cent. acetic acid to make the final sample weakly acid. The urine was dialyzed through a Cellophane membrane to remove salts and urea which would interfere with the anti-diuretic assay. It was then concentrated *in vacuo* to a small volume and the anti-diuretic activity determined by the rat method of Burn as described by Heller and Urban.[2] This method is based upon the rate of renal excretion of water in rats that have been hydrated to the extent of 5 per cent. of their body weight. Each sample was assayed collectively on four rats, the time for the excretion of 50 per cent. of the fluid administered being taken as the index of antidiuresis. A difference of five milli-units of pitressin can be detected by this method. The procedure of dialysis was controlled with known solutions of pituitrin, which showed no demonstrable loss

[1] G. W. Theobald, *Clinical Science*, 1: 225–239, 1934.
[2] H. Heller and F. F. Urban, *Jour. Physiol.*, 85: 502–518, 1935.

of activity over the three-hour period necessary to dialyze the urine free from chloride.

The results in rats may be briefly summarized by the citation of several characteristic experiments.

(1) The combined urine excretion of 12 animals, normally hydrated and given free access to water, collected over 24 hours and reduced to 10 cc, exhibited no anti-diuretic activity when injected into assay rats at the dose level of 1 cc/100 g.

(2) The combined six-hour excretion of 12 rats after the administration of 5 cc/100 g of 5 per cent. NaCl contained, in repeated experiments, from 100 to 200 milli-units of anti-diuretic substance, expressed as units of a pituitrin solution (Parke, Davis and Company, 20 pressor units per cc) possessing comparable anti-diuretic activity.

(3) The combined excretion over the subsequent 18 hours collected from 12 rats treated as above consistently contained 200 milli-units of anti-diuretic substance.

(4) Twelve rats dehydrated by withholding water for 24 hours excreted a total of 100 milli-units of anti-diuretic substance.

(5) The same rats dehydrated over an additional 24 hours excreted in that period 200 milli-units of anti-diuretic substance.

(6) Twenty rats dehydrated over a period of 72 hours excreted a total of 5 units of anti-diuretic substance.

Dogs proved more variable than rats in their response. The most striking result was obtained in a female collie. This animal during the first 24 hours of dehydration excreted 0.1 unit. After an additional 24 hours of dehydration, the urine contained approximately 5 units.

Anti-diuretic activity of the urine of monkeys and man has also been observed.

That the anti-diuretic substance found in the urine has its origin in the posterior pituitary gland and is probably identical in nature to the pharmacological preparations derived from that gland is based on the following evidence:

(1) Hypophysectomized rats,[3] dehydrated to the point of death (40 hours), fail to secrete this anti-diuretic substance in their urine. Control rats under identical experimental conditions always show appreciable amounts.

(2) Both the anti-diuretic substance of the urine and solutions of pituitrin (Parke, Davis and Company) of the same anti-diuretic strength are destroyed to the same degree by (a) 30-minute hydrolysis with 1 per cent. HCl, (b) 30-minute hydrolysis with 2N NaOH and (c) 30-minute reduction with 0.1N Na_2SO_3.

[3] Kindly prepared and examined post-mortem by Dr. Robert T. Hill, of the department of anatomy.

(3) The molecular size of both the anti-diuretic substance extracted from the pituitary and that excreted by the kidney is such that no appreciable loss in activity results from a 3-hour dialysis with a Cellophane membrane with a wall thickness of 0.00072 inches.

The authors interpret the above experiments as strong evidence that (1) an anti-diuretic substance is secreted by the posterior pituitary, (2) this substance is a true hormone, passes into the circulation and acts upon the kidney, (3) the pituitary hormone in its circulation through the kidney filters through the glomerulus and escapes into the urine, in which it is relatively stable and easily detectable, (4) the need for water conservation by the body is a stimulus for the secretion of this hormone.

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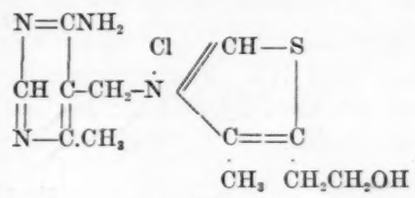
RESEARCHES ON PYRIMIDINES. CLIII. THE STRUCTURE OF VITAMIN B_1

STRUCTURE I has been proposed by the Japanese investigators Makino and Imai[1] for vitamin B_1. They are the first investigators to suggest a structure formulated on the basis that the thiazol cycle of the vitamin is joined to the pyrimidine moiety through an aliphatic methylene group (CH_2). A methyl group is represented as being substituted for hydrogen in position – 4 of the pyrimidine ring in the vitamin.



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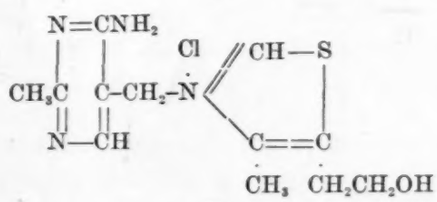


II

In a recent publication by R. R. Williams,[2] this investigator has presented new chemical evidence to support the postulation of the Japanese workers and has revised his vitamin B_1 formula previously proposed.[3] Williams now feels justified in proposing

[1] *Jour. physiolog. Chemie*, 239, Heft 1; Private communication, February 14, 1936.

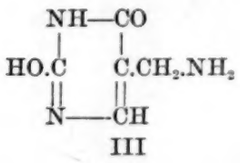
[2] Communication to the editor of the *Jour. Am. Chem. Soc.*, dated May 23, 1936, Vol. 58: 1065, 1936.

[3] Williams, *Jour. Am. Chem. Soc.*, 57: 229, 1935.

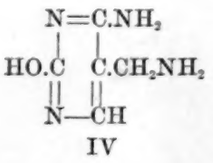
structure II for this vitamin, which differs from the Makino and Imai formulation in one respect only; in the position assigned to the methyl group substituted in the pyrimidine ring. In the Japanese formula I this group is substituted in position – 4, while in formula II the methyl radical occupies position – 2 of the pyrimidine cycle.

These conclusions are very important and add new interest to experimental work which has been in progress in the Yale Laboratory for several months. We are dealing here with a new and most interesting postulation, in so far as our knowledge of pyrimidine chemistry is concerned, and that is the fact that a side chain substitution characterizes the structure of the pyrimidine moiety of the vitamin molecule. We have at present very limited knowledge of the chemistry of such pyrimidine constructions, and evidence has been accumulated in pyrimidine researches already carried out in the Yale Laboratory showing that pyrimidine derivatives of this type are characterized by unique chemical properties. The study of several of these representatives of physiological interest is now in progress.

Predicating the probable physiological importance of several of these pyrimidine derivatives of the uracil type, the senior author started new work on this subject in 1934 and decided to undertake at first the development of a practical method for synthesizing the hitherto unknown amino derivative of thymine, namely, "Thyminyl-amine" III. This pyrimidine may be considered as an oxidized form of the pyrimidine cycle functioning in vitamin B_1. Its structural relationship to the proposed vitamin formulas, I or II, is clearly revealed when its constitution is expressed in its enolic form III. The corresponding 6-amino-pyrimidine expressed by formula IV is a derivative of 5-methylcytosine.



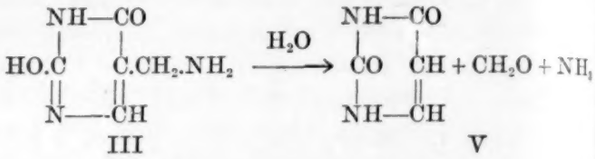
III



IV

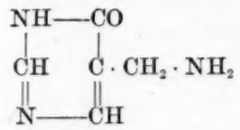
Due to a serious illness the senior author was unable to carry out his complete program of synthesis during 1935, and he turned over a part of the work to an assistant, Miss Anne Litzinger, who has accomplished successfully the synthesis of the desired thyminyl-amine III. A description of this synthesis will be presented for publication in a future number of the *Journal of the American Chemical Society*. Work dealing with the synthesis of the amino derivative of 5-methylcytosine IV is now in progress.

While the complete details of Miss Litzinger's investigation will not be reported in full until later, we do wish to make known at this time a characteristic chemical behavior of thyminyl-amine III when an aqueous solution of this pyrimidine is heated. Under such conditions the amine is broken down smoothly with formation of uracil V, formaldehyde and ammonia. This hydrolytic degradation is expressed by the equation below:



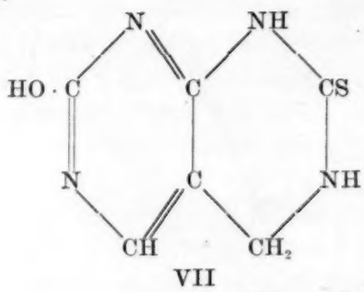
III V

In the form of its salts the pyrimidine base interacts normally as a primary amine and its derivatives crystallize well and are easily purified. The question whether a corresponding aliphatic amine of the type represented by formula VI will undergo a similar change by hydrolysis will soon be decided in this laboratory.



VI

Starting with the methyl-cytosine derivative IV it will be possible for us to synthesize a cyclic thiourea leading to the formation of a *thiodipyrimidine*, VII. Such a construction is of immediate biochemical interest on account of its possible structural relationship to *thiochrome*.



VII

TREAT B. JOHNSON
ANNE LITZINGER

STERLING CHEMISTRY LABORATORY
OF YALE UNIVERSITY

BOOKS RECEIVED

EDSER, EDWIN, The late. *Heat for Advanced Students*. Revised edition by N. M. BLIGH. Pp. x + 487. 2[illegible] figures. Macmillan. $1.75.

MACDOUGALL, FRANK H. *Physical Chemistry*. Pp. ix + 721. 95 figures. Macmillan. $4.00.

NEWMAN, HORATIO H. *Outlines of General Zoölogy*. Third edition. Pp. xxvii + 661. 273 figures. Macmillan. $3.50.

PEATTIE, DONALD C. *Green Laurels; The Lives and Achievements of the Great Naturalists*. Pp. xxiii + 36[illegible] 32 plates. Simon and Schuster. $3.75.

ROEHL, KATHERINE MCC., and H. H. NEWMAN. *A Laboratory Manual for General Zoölogy*. Pp. vii + 99. [illegible] figures. Macmillan. $1.00.

WOODRUFF, LORANDE L. *Foundations of Biology*. Fifth edition. Pp. xiv + 583. 377 figures. Macmillan. $3.[illegible]